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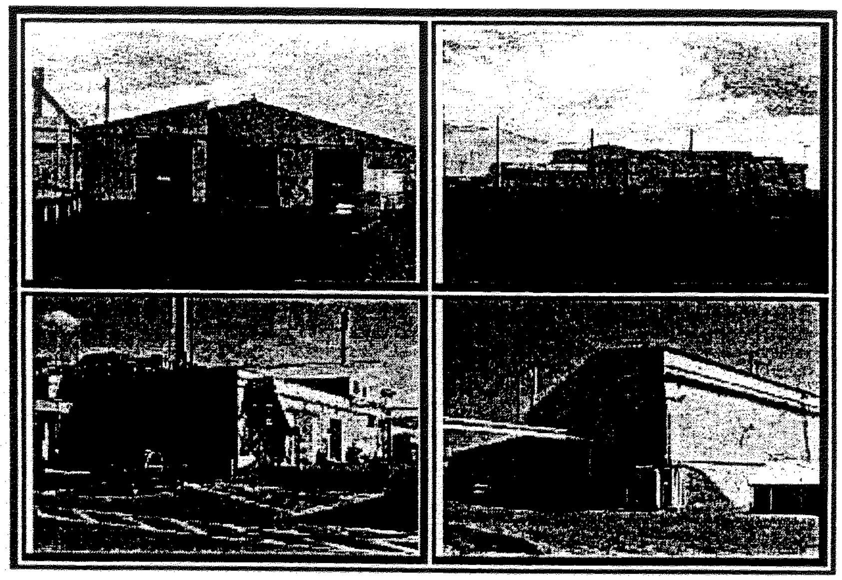
PRELIMINARY DRAFT
Environmental Assessment and Deactivation Plan

For Obsolete Spent Nuclear Fuel Processing, Storage, and Support Facilities at the Idaho Nuclear Technology and Engineering Center (INTEC)



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For Obsolete Spent Nuclear Fuel Processing, Storage, and Support Facilities at the Idaho Nuclear Technology and Engineering Center (INTEC)

Published August 1998

Prepared for the
U. S. Department of Energy
DOE Idaho Operations Office

HELPFUL INFORMATION FOR THE READER

Scientific Notation

Scientists use scientific notation to express numbers that are very small or very large. This EA expresses a very small number with a negative exponent, such as 1.3×10^{-6}. To convert this number to the more commonly used form, move the decimal point left by the number of places equal to the exponent, in this case 6. The number thus becomes 0.0000013. For large numbers, those with a positive exponent, move the decimal point to the right by the number of places equal to the exponent. This EA writes the number 1,000,000 as 1.0×10^{6}. This document uses English units with conversion to metric units provided below.

Units

cm	centimeter(s)
Ci	curie
ft	foot (feet)
ft^2	square foot (feet)
ft^3	cubic foot (feet)
in.	inch(es)
km	kilometer(s)
km^2	square kilometer(s)
m	meter(s)
m^2	square meter(s)
m^3	cubic meter(s)
$mi.^2$	square mile(s)
mrem	millrem(s) (1/1000th of a rem)
pCi	picocuries (10^{-12})
rem	roentgen equivalent man (measure of radiation exposure)
R	Roentgen

Conversions

Metric to English

To Convert	Multiply By	To Obtain
cubic meters	3.531×10^{1}	cubic feet
cubic meters	1.308	cubic yards
liters	2.64×10^{-1}	gallons
kilograms	2.205	pounds
kilometers	6.214×10^{-1}	miles
meters	3.28084	feet
meters	1.093613	yards
square km	3.861×10^{-1}	square mi.
square meters	1.196	square yards
kilograms	1.1×10^{-3}	tons

English to Metric

To Convert	Multiply By	To Obtain
cubic feet	2.8×10^{-2}	cubic meters
cubic yards	7.646×10^{-1}	cubic meters
gallons	3.785	liters
pounds	4.54×10^{-1}	kilograms
miles	1.609334	kilometers
feet	3.048×10^{-1}	meters
yards	9.144×10^{-1}	meters
square mi.	2.590	square km
square yards	8.361×10^{-1}	square meters
tons	9.07185×10^{2}	kilograms

Units of Radioactivity, Radiation Exposure and Dose

The basic unit of radioactivity used in this report is the curie (Ci). The curie, based on one-gram of radionuclide Radium-226, decays at the rate of 37 billion disintegrations per second. For any other radionuclide, one curie is the amount of that radionuclide that decays at this rate.

Radiation exposure is expressed as Roentgen (R), the amount of ionization produced by gamma radiation in air. Dose or units of "Roentgen equivalent man" or rem measure the effect of radiation on tissues.

Source of Radiation

Sources of ionizing radiation expose every person living in the United States or the world to radiant energy as ions pass through cells. Three general types of radiation sources are those of natural origin unaffected by human activities, those of natural origin but enhanced by human activities and those produced by human activities.

The first group includes terrestrial radiation from natural radiation sources in the ground, cosmic radiation from outer space and radiation from radionuclides naturally present in the body. Exposures to natural sources may vary depending upon the geographical location and even the altitude at which a person resides. When such exposures are much higher than the average, they are considered elevated.

The second group includes a variety of natural sources. Human actions increase the radiation from these sources. For example, radon exposures in a given home may be elevated because of natural radionuclides in the soil and rock on which the house is built. However, characteristics of the home, such as extensive insulation may enhance radon exposures of occupants. Another example is the increased exposure to cosmic radiation that airplane passengers receive when traveling at high altitudes.

Three general types of radiation sources are those of natural origin unaffected by human activities, those of natural origin but enhanced by human activities and those produced by human activities.

The third group includes a variety of exposures from materials and devices such as medical x-rays, radiopharmaceuticals used to diagnose and treat disease and consumer products containing minute quantities of radioactive materials. Exposures may also result from radioactive fallout from nuclear weapons testing, accidents at nuclear power plants, and other episodic events caused by human activity in the nuclear industry. Except for major nuclear accidents, such as the one that occurred at Chernobyl, exposure of workers and members of the public from activities at nuclear industries is very small compared with exposures from natural sources.[1]

The terms deactivate, decontaminate, and dismantle have specific definitions (see glossary, p. 54). For the purpose of this discussion, the EA combines the meaning of these terms under the term "deactivate" or "deactivation." The proposed action involves deactivation, decontamination, and dismantlement of parts or all of their structure, system, and components.

1 Paraphrased from National Council on Radiation Protection and Measurements, *Ionizing radiation Exposure of the Populations of the United States*, NCRP Report No. 93, September 1, 1987, p. 1.

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FIGURES

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ACRONMYS AND ABBREVIATIONS

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Environmental Assessment and Deactivation Plan

For Obsolete Spent Nuclear Fuel Processing, Storage, and Support Facilities at the Idaho Nuclear Technology and Engineering Center (INTEC)

1 INTRODUCTION

1.1 Purpose and Need

The U. S. Department of Energy (DOE) proposes to deactivate[2], obsolete spent nuclear fuel processing, storage, and support facilities located at the Idaho Nuclear Technology and Engineering Center (INTEC) on the Idaho National Engineering and Environmental Laboratory (INEEL) (Figure 1). In addition, Lockheed Martin Idaho Technologies Company (LMITCO)[3] would close several Resource Conservation and Recovery Act (RCRA) units during the deactivation of these facilities (see Section 2.4.2, page 16).

The processes housed in these buildings are no longer operational and DOE has not identified any future use for the processes or buildings. These facilities include:

- INTEC-601 - "Fuel Processing Complex"
- INTEC-627 - "Remote Analytical Facility"
- INTEC-640 - "Headend Processing Plant"
- INTEC-603 - "Fuel Receipt and Storage Facility."

The purpose of the proposed action is to reduce the risk of **radioactive exposure**[4] and release of hazardous constituents and eliminate the need for extensive long-term surveillance and maintenance.

The State of Idaho regulates facilities, called treatment, storage, and disposal facilities (TSDFs), that treat, store, or dispose of hazardous wastes. Through the State of Idaho Administrative Procedures Act (IDAPA), the State of Idaho is authorized by the Environmental Protection Agency (EPA) to enforce the Resource Conservation and Recovery Act (RCRA). This Act oversees the management of hazardous waste. The State of Idaho Hazardous Waste Management Act (HWMA)[5] requires that interim status units no longer needed must undergo closure. Consequently, the proposed RCRA closures must comply with Idaho Rules and Standards for Hazardous Waste contained in the Idaho Administrative Procedures Act (IDAPA) Section 16.01.05 (see Section 5.2, page 46).

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2 The terms deactivate, decontaminate, and dismantle have specific definitions (see glossary, p. 54). For the purpose of this discussion, the EA combines the meaning of these terms under the term "deactivate" or "deactivation." The proposed action involves deactivation, decontamination, and dismantlement of parts or all of their structure, system, and components.

3 LMITCO is the prime contractor for the U. S. Department of Energy Idaho Operations Office.

4 The Glossary, page 54, defines all words highlighted in **boldface**.

5 The Environmental Protection Agency granted the State of Idaho final authorization to operate its hazardous waste program instead of the federal RCRA program on April 9, 1990. To avoid confusion, this document uses the RCRA citations adopted by the State of Idaho instead of the Idaho Administrative Procedure Act citation.

1.2 Background

The DOE is currently evaluating its options for the disposition of several obsolete spent nuclear fuel processing, storage, and support facilities at the INEEL. An essential element of DOE's decisionmaking is a thorough understanding of the environmental impacts that may occur during the implementation of the proposed action. The **National Environmental Policy Act** (NEPA) of 1969, as amended, provides Federal agency decisionmakers with a process to consider potential environmental consequences of proposed actions before agencies make decisions. In following this process, DOE has prepared this draft **Environmental Assessment** (EA) to assess the proposed action and **alternatives**. Following consideration of public comments, DOE will prepare a final EA. DOE will discuss its decisions in a **Finding of No Significant Impact** (FONSI) document or determine that an **Environmental Impact Statement** (EIS) be prepared.

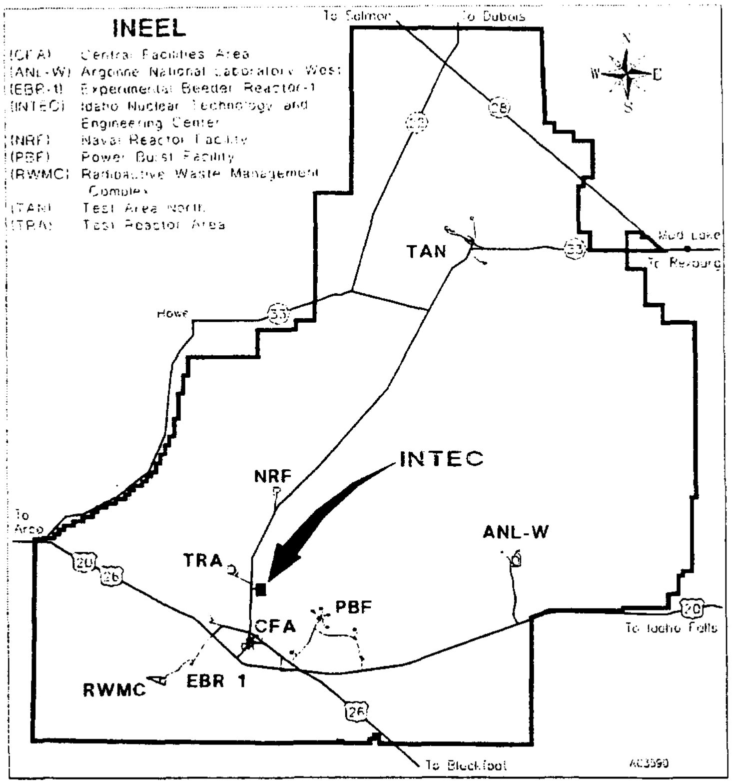

Figure 1. Location of the INTEC on the Idaho National Engineering and Environmental Laboratory.

The proposed action includes elements that constitute the **decommissioning** of structures and components considered major **spent nuclear fuel** treatment facilities. Under DOE NEPA Implementing Procedures, actions of this type normally require the preparation of an EIS.[6] Nevertheless, risk analyses have been prepared that indicate that the proposed action would result in little or no cumulative risk or impact to health or the environment. Also, in accordance with DOE-ID=s **Internal Scoping Procedures** for NEPA, the DOE-ID NEPA Planning Board has recommended that an EA be prepared to determine whether a FONSI may be appropriate. Therefore, DOE has prepared this EA to analyze the environmental impacts of the proposed and alternative actions further.

Based on [this] EA and public review, DOE will prepare a Finding of No Significant Impact and proceed with the action(s), or prepare an EIS. . .

The FEIS's[7] **Record of Decision** (ROD) also addresses the proposed action (DOE 1995a, DOE 1995b). The FEIS is comprised of two volumes. Volume 1 considers programmatic (DOE-wide) alternative approaches to managing existing and projected quantities of spent nuclear fuel until the year 2035. Volume 2 addresses alternative approaches for management of DOE's environmental restoration, waste management, and spent nuclear fuel activities over the next 10 years at

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6 Elements of the proposed deactivation projects are addressed in the DOE NEPA Implementing Procedures at 10 CFR 1201, Appendix D to Subpart D, "Classes of Actions that Normally Require Environmental Impact Statements (EISs)" Subsection D10; "*Siting / construction / operation / decommissioning of major treatment, storage, and disposal facilities for high-level waste and spent nuclear fuel.*"

7 U. S. Department of Energy, 1995, *Record of Decision, Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Environmental Impact Statement*, U. S. Department of Energy, Office of Environmental Management, Idaho Operations Office, May 30, 1995.

the INEEL. The ROD selected the "Modified Ten-Year Plan Alternative" for implementation at the INEEL. As part of the decision, DOE determined that certain projects evaluated in the FEIS would go forward, while deferring other actions. For the proposed deactivation of INTEC-601, 603, and 640 the ROD states; "*Implementation decisions will be made in the future pending further project definition, funding priorities, and any further review under the* ***Comprehensive Environmental Response, Compensation, and Liability Act or the National Environmental Policy Act***" or (CERCLA). DOE is transferring the spent fuel stored under water in INTEC-603 to newer storage facilities at the INTEC. Upon satisfactory completion of the spent fuel transfer effort, DOE would monitor INTEC-603 to ensure contamination in the facility is contained and public and worker safety maintained (DOE 1995a).

This EA provides the further NEPA review directed by the ROD for INTEC-601, 603, and 640 with the addition of the deactivation of INTEC-627 that was not addressed in the FEIS.

1.2.1 Facility Description

The DOE considers the facilities discussed below obsolete and in some cases deteriorating and therefore has not designated them for future use. See Section 2 for a detailed description of the proposed action and alternative actions for each of these facilities. This EA treats INTEC-601, -627, and -640 as an integral unit (INTEC-601 Complex), while INTEC-603 and associated buildings are treated separately (INTEC-603 Complex) (Figure 2). See Figure 3 andFigure 4 for an illustrated layout of INTEC-601 and plan layout of INTEC-603 complexes.

1.2.2 Fuel Processing Complex, INTEC-601

The INTEC-601 facility contains chemical processing equipment used to recover uranium from various types of nuclear fuel. The facility is essentially rectangular (244-feet by 102-feet) and consists of five levels (up to 95 feet high, mostly below ground). The top level is above grade and contains an open area that workers used to transfer fuel elements to the process equipment and for chemical storage, makeup, and transfer. The top level is constructed of **transite** panels (containing asbestos) and structural steel. The lower levels, constructed of reinforced concrete with walls up to 5 feet thick, are largely below ground.

The lower levels contain 29 process cells (most of which are about 20 feet square and 28 feet high), numerous corridors, and auxiliary cells that house equipment and controls (Figure 3). The largest cell is approximately 60 feet by 20 feet by 40 feet high. Stainless steel lines the floor and part of the walls of each cell and most of the equipment is stainless steel. Most of the processing equipment in the building is in the heavily shielded cells, designed for remote operation.

The government constructed the building in 1953. DOE ended nuclear fuel reprocessing at INTEC-601 in 1992 and the facility was no longer needed making the facility obsolete for the originally intended mission. The facility is in surveillance and maintenance status until DOE decides to convert it to a new use or to dismantle it.

1.2.3 Remote Analytical Facility, INTEC-627

INTEC-627 is entirely above ground and constructed of reinforced concrete and masonry block. This facility is co-located with INTEC-601 and was used for small-scale custom **dissolution** processes and included the Hot Chemistry Laboratory, Shift Lab, Remote Analytical Facility, Multi-Curie Cell, and the Decontamination Support Facility. DOE constructed this facility in 1955. INTEC-627 is deteriorating, and DOE is not considering it for future operation or reuse.

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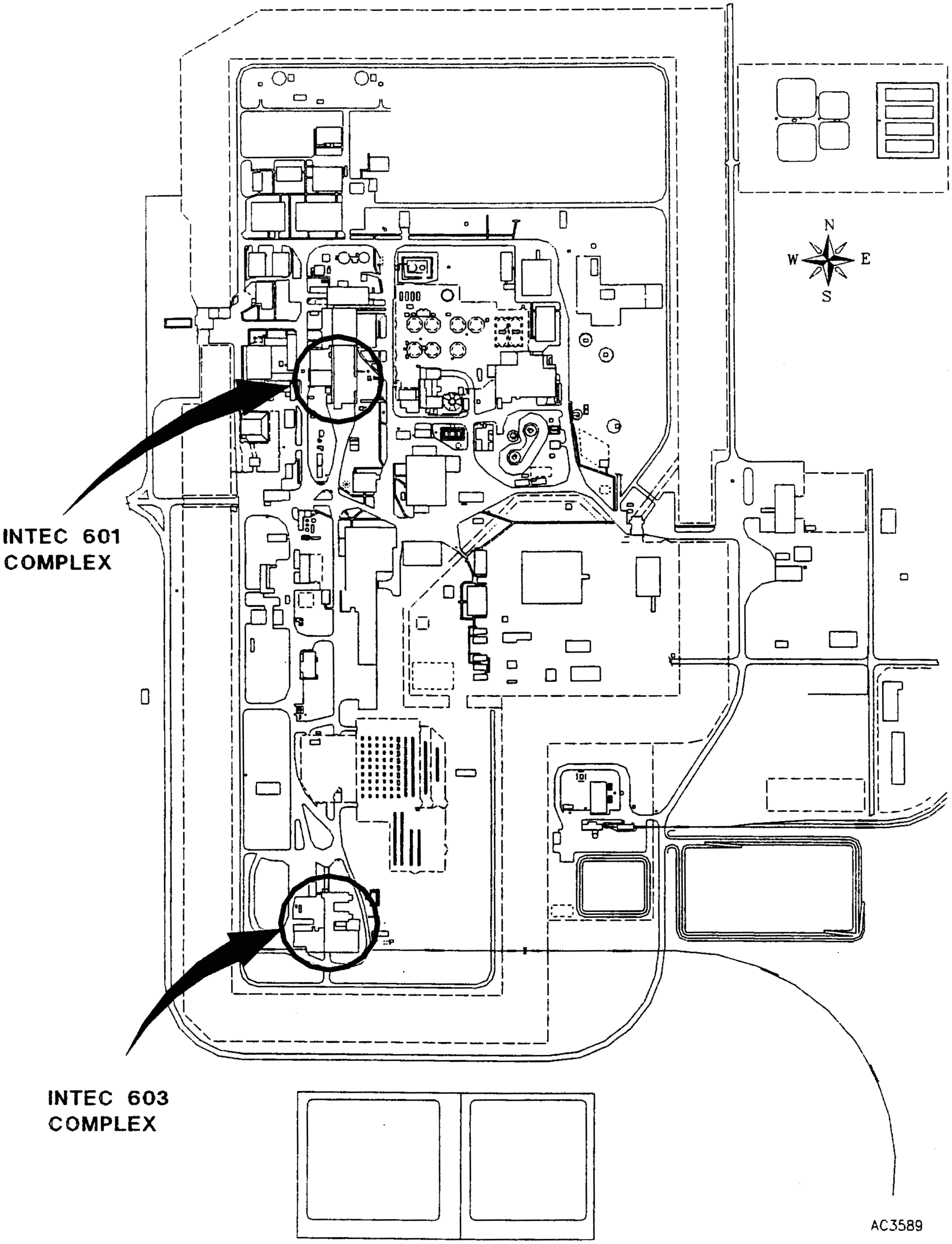

Figure 2. INTEC Showing Location of INTEC-601 Complex and INTEC-603 Complex.

1.2.4 Headend Processing Plant, INTEC-640

The **Headend** Processing Plant contains approximately 15,000 square feet of floor space and houses two unique spent fuel headend processing systems and a liquid waste collection system: ROVER and Electrolytic Dissolution Process (EDP). The ROVER and EDP headends operated in heavily shielded concrete and steel hot cell units with remote manipulation capabilities and some remote maintenance capabilities. The "liquid waste collection system" includes three tanks in heavily shielded concrete vaults situated below the hot cell units.

DOE shut down the ROVER and EDP processes in 1984 and 1981, respectively. Workers have removed much of the process chemical and radionuclide inventory from the headend systems, but both systems remain highly contaminated. The liquid waste system is included in the RCRA Part A permit. DOE constructed the building in 1961. The facility is in surveillance and maintenance status until DOE decides to convert it to a new use or to dismantle it.

1.2.5 Fuel Receipt and Storage Facility, INTEC-603

INTEC-603 contains two primary spent nuclear fuel facilities (Figure 4). They are the Fuel Receiving and Storage Facility (FRSF) and the Irradiated Fuel Storage Facility (IFSF). The FRSF contains three underwater fuel storage basins. This portion of INTEC-603 was used to receive, unload, and provide underwater storage for fuel. The Fuel Element Cutting Facility (FECF) is in the FRSF portion of the building. FECF is a hot cell previously used for cutting fuel.

The INTEC-603 underwater storage basins began operation in 1953. DOE plans to operate the basins through at least 1999 (see Section 1.2). The basins, constructed of reinforced concrete, are without liners or a leak-detection system. The basin storage portion of INTEC-603, covering approximately 10,000 square feet, provides underwater storage for spent nuclear fuel involving approximately 1,500,000 gallons of filtered water. The three interconnected basins include support processes to treat and maintain the basin water quality, including filtration, ion exchange, chloride removal, reverse osmosis demineralization, and ultraviolet light sterilization. The integrity of the basin portion of the facility and its fuel handling monorail system have become suspect because the facility was constructed to seismic criteria of the early 1950s. The affected facility interior surfaces, equipment, structures, interior cell areas (Fuel Element Cutting Facility), and the building exterior require radiological and hazardous substance decontamination. DOE constructed INTEC-603 in 1953.

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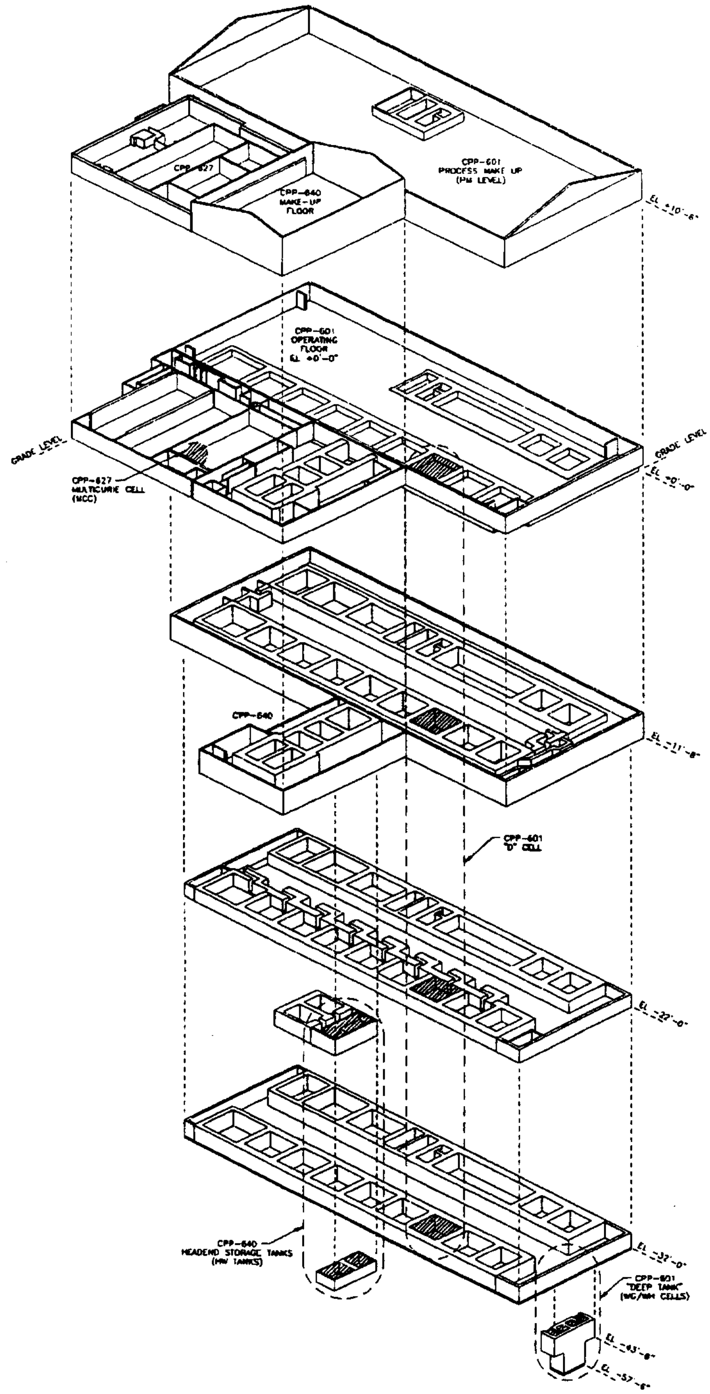

Figure 3. Illustration of INTEC-601 Complex Levels with PM-Level, Ground Level, and RCRA Units Identified.

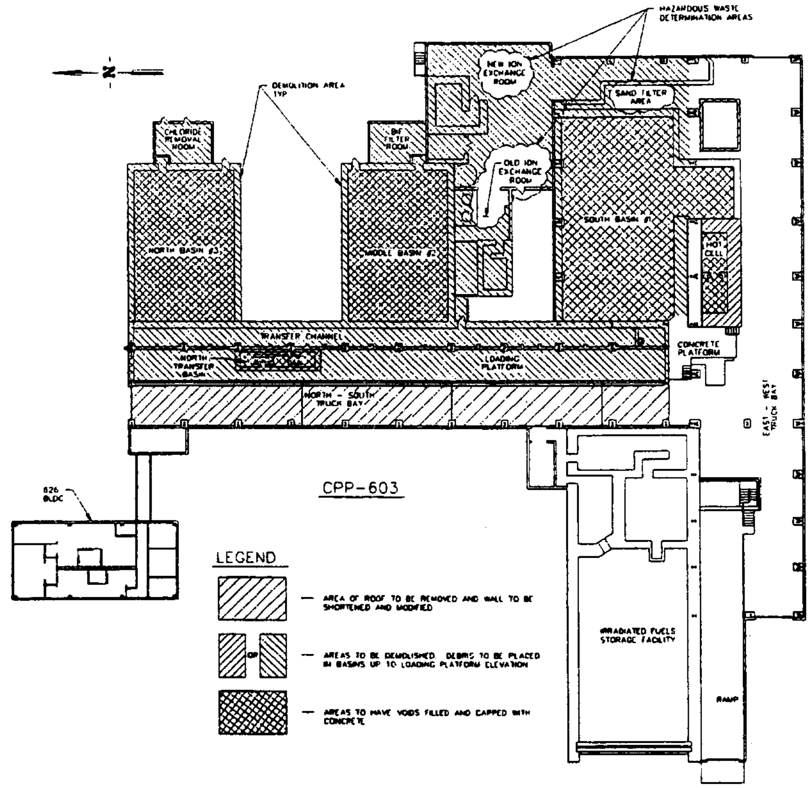

Figure 4. Plan View of INTEC-603 Complex.

2 DESCRIPTION OF ALTERNATIVES

The following sections discuss three primary alternatives for the closure of the Fuel Reprocessing Complex (FRC) – INTEC-601, -627, and -640 and the Fuel Receipt and Storage Facility (FRSF) – INTEC-603. This EA treats INTEC-601, -627, and -640 as an integral unit (INTEC-601 Complex), while INTEC-603 and associated buildings are treated separately (INTEC-603 Complex). The proposed action includes the deactivation of one or both of these "complexes." These include (1) Deactivate and Leave In-place as described in Section 2.1, (2) Deactivate and Remove as described in Section 2.2, and (3) No Action, as described in Section 2.3. This document also discusses several sub alternatives related to deactivating the complexes (1a - 1d). In addition, Section 2.4 discusses several options related to airflow through the Air Protection System and RCRA Closures. The airflow options relate only to the INTEC-601 Complex and associated sub alternatives. The RCRA Closure options relate to both the INTEC-601 Complex and the INTEC-603 Complex.

Figure 5 illustrates DOE's proposed action and the possible combination of alternatives and options. DOE believes that these alternatives and options give an adequate range to describe potential impacts to the environment and worker and public safety. The goals of deactivation are to minimize the need for further maintenance and to control, minimize, or eliminate the post-deactivation release of hazardous or radioactive contamination from the facilities.

○ Circle represents possible combination of alternatives and options
● Shaded circle represents alternatives and option for the proposed action
⊗ Not applicable

	Buildings: CPP-601 Complex	Buildings: CPP-603 Complex	Options: Replace APS Airflow	Options: Reduce APS Airflow	Options: RCRA Clean Closure*	Options: RCRA Landfill Closure**
Alternatives						
Deactivate In-Place						
Sub Alternatives						
1a - Grout In-Place Above Ground Level - INTEC 601	●	⊗	●	○	●	○
1b - Grout In-Place at Ground Level - INTEC 601	○	●	○	○	○	○
1c - Interim State - INTECT 601	○	⊗	⊗	⊗	⊗	⊗
1d - Grout In-Place at Ground Level - INTEC 603	⊗	●	○	○	○	⊗
2 - **Deactivate By-Removal**	○	○	○	○	○	○
No Action						
3a - Continue "On-Going" Operations	○	○	⊗	⊗	⊗	⊗
3b - Discontinue "On-Going" Operations	○	○	⊗	⊗	⊗	⊗
Options						
Replace APS Airflow	●	⊗				
Reduce APS Airflow	○	⊗				
RCRA Clean Closure*	●	●				
RCRA Landfill Closure**	○	○				

* Performance Standard Base Closure
** Closure to Landfill Standards

Figure 5. Alternative and Option Matrix.

2.1 Alternative 1 (Proposed): Deactivate and Leave In-Place the INTEC-601 Complex and INTEC-603 Complex

The general intent of this alternative is to deactivate these facilities and provide a safe configuration to guard against releases of radiological and hazardous contaminants to the environment. This alternative proposes to deactivate the facilities by either 1) dismantling the superstructure to the PM level and **grouting in-place** the rest of the structure, 2) dismantling to ground level and grouting in-place, or 3) dismantling INTEC-601 Complex to the PM level and leaving in an interim state[8] and/or dismantling INTEC-603 Complex to ground level and grout in-place. Table 1 provides additional information related to the proposed action at each of the facilities.

2.1.1 Sub Alternatives and Options for Deactivating INTEC-601 Complex

2.1.1.1 Deactivate to PM Level and Grout In-Place (Alternative 1a)

Deactivation Activities – The proposed action would deactivate and grout in-place

- INTEC-601 below the Process Make-up (PM) level,
- INTEC-640 below the second floor to the same level of INTEC-601 PM level,
- INTEC-627 below the second floor to the level of INTEC-601 PM level.

The PM floor is 10½ feet above ground level (see Figure 3). The upper section of the P, Q, and R cells in INTEC-601, which extends 8½ feet above the PM floor, would remain. In addition, about 3 feet of the Mechanical Handling Cave in INTEC-640 would remain above the level of the PM floor.

Table 1. Facility Specific Deactivation Activities for the Proposed Alternative.

Facility	Deactivation Activity[a]
Fuel Processing Building, INTEC-601	▪ Removing all piping and equipment from the PM level up to the roof. ▪ Dismantling the superstructure above the PM level. ▪ Grouting the remaining above and below grade substructure in-place ▪ Relocating the low level liquid waste collection, sample and transfer process ▪ Relocating the chemical transfer and make-up process. ▪ Close deep tanks and D Cell to performance standards.
Remote Analytical Facility, INTEC-627	▪ Removing all piping and equipment to the same elevation as the INTEC-601 PM level ▪ Removing the superstructure above the PM level ▪ Grouting the remaining above grade structure in-place. ▪ Close Multi Curie Cell to performance standards.
Headend Processing Plant, INTEC-640	▪ Remove all piping and equipment from the PM level up to the roof ▪ Remove the superstructure above the PM level ▪ Grout the remaining above and below grade structure in-place. ▪ Close Headend Holdup Storage Tanks to performance standards.
Fuel Receipt and Storage Facility, INTEC-603	▪ Dismantle the Fuel Element Cutting Facility, the North-South Truck Bay superstructure, and equipment associated with spent nuclear fuel storage operations, the INTEC-648 (Sludge Tank Control House) superstructure, and associated equipment. ▪ Leave the Solid Waste Collection Tank in the vault and RCRA close in-place. ▪ Dismantle materials, place it in the facility's below-grade basins, and then fill the below-grade basins with grout.

a. Where possible, workers would place superstructure and equipment found above grade in the below grade areas before grouting in-place.

Radiological workers would survey process equipment in the relatively non-contaminated above-grade areas for radioactive contamination. When possible, workers would decontaminate equipment and remove it for salvage or cut it apart and place it on the PM floor or in various low-radiation below-grade areas. Following radiation surveys and hot-spot stabilization with fixatives, construction workers would dismantle and **size** the roof and walls using a backhoe with a crushing and shear jaw attachment or similar equipment. The roofing and walls consist of transite siding, that contains asbestos, or **precast** pumice blocks. The asbestos materials in the roof and siding are intact and **nonfriable**. Workers using backhoes would place debris from walls, roof, and superstructure in the below-grade areas or on the PM floor. Some material may need to be hand carried and placed in below-grade areas. The application of water or other dust suppressants during the dismantling and sizing steps would control suspension of radioactive or asbestos particles. Following leveling and compaction of debris by track mounted equipment, such as bulldozers, workers would pump grout into below-grade areas.

Finally, workers would place a concrete cover over the superstructure placed on the PM floor and over the upper portions of the cells that are above the PM floor. When the action is complete, workers would place a concrete cap over the top of the grouted structure or level with the highest remaining superstructure (about 20 feet above ground level). DOE would continue to provide services such as the deep tank waste accumulation and transfer system, the chemical makeup system, and distribution of utilities by transferring their functions to other locations. Workers would reroute these systems and construct new facilities as necessary to continue operations at the INTEC.

Workers would sequence deactivation activities to reduce radionuclide resuspension and to control emissions. They would seal potential emission pathways, and existing duct work to the INTEC Atmospheric Protection System (APS) would be grouted in stages to provide continued collection, filtration and monitoring of air expelled during most of the deactivation process. The APS is a network of ducts, fans, high efficiency particulate air (HEPA) filters, etc. that vent INTEC facilities, such as the INTEC-601 Complex and New Waste Calciner Facility (NWCF) to the stack. Workers would also decontaminate surfaces or stabilize contamination with fixatives before dismantling the above-grade structures. The nature of the deactivation process, such as slowly filling the piping and vessels with a wet grout mixture, would help fix and hold radioactive residues with minimal resuspension into the air.

Install or Relocate:

- ***Deep tanks***
- ***Chemical Makeup System***
- ***Offgas system***
- ***Remote Distribution Modules***

Decontaminate, clean, remove, dismantle, or modify:

- ***Clarkson feeder***
- ***Electrical system***
- ***Old Chemical Makeup System***

Grouting-in-place would minimize the generation of waste requiring treatment, storage, or disposal at other facilities and personal radiation exposure. DOE would leave below-grade components such as tanks, piping, miscellaneous equipment, and fill with grout areas such as cells, operating areas, and stairwells. DOE would close the RCRA-regulated units to **performance standards** (see Section 2.4). In addition, workers would cap waste lines going from the facility and grout the rooms as part of the RCRA closure activity.

In addition, deactivation activities would generate a few cubic feet of waste material, mostly from anti-contamination clothing, grout hoses and connections, and grout truck clean-out residue. The anti-contamination clothing would be volume reduced by compaction or incineration at the Waste Experimental Reduction Facility and disposed of at an approved facility, such as the Radioactive Waste Management Complex. Workers would dispose of uncontaminated wastes such as hoses, forms, and grout residue that cannot be reused or recycled in the INEEL landfill at CFA or at designated grout truck clean out areas.

Post-Deactivation Activities – In addition to INTEC-601, -627, and -640, the INTEC contains several known hazardous substance release sites that are undergoing review and corrective action under the **Comprehensive Environmental Response, Compensation, and Liability Act** (CERCLA). DOE expects to close some of the CERCLA sites with waste in-place, thus requiring maintenance and monitoring for many years in the future. To eliminate duplication of effort and cost, the CERCLA program would assume post-closure cover maintenance, groundwater and asbestos monitoring, notices, certifications, and security for these facilities. In addition, DOE would require definition and development of specific requirements in the CERCLA Long-Term Monitoring Plan. For instance, the CERCLA program would be required to inspect the concrete covers at least annually for cracks and degradation of the joint seals between the sections. Workers would repair any identified cracks and deteriorating seals in the concrete covers. The CERCLA program would also monitor groundwater consistent with the Record of Decision for the comprehensive CERCLA Remedial Investigation / Feasibility Study for the INTEC.

New Construction – Deactivation activities would require the construction of new deep tanks and chemical makeup system described below.

Construction of new tanks would replace the existing Deep Tanks, VES-WG-100/-101 and VES-WH-100/-101, located in INTEC-601. They currently collect the liquid laboratory wastes from INTEC-602/-601, and –684 and transfer it to INTEC-604. The New Deep Tanks would use the existing Westside Waste Holdup Tanks to replace the function of the existing Deep Tanks. LMITCO would upgrade these tanks to meet RCRA requirements. The vault would be lined and improved sampling capabilities added. The tanks are three vessels in an underground tank vault to the north of INTEC-641. Workers would route new piping from the laboratory drains in INTEC-602 to the Westside Waste Holdup Tank Vault, then connect the piping from INTEC-684. Workers would also route discharge piping from the New Deep Tanks to the Process Equipment Waste Evaporator in INTEC-604. All of the piping would be placed in a lined trench or have secondary containment.

Construction of a new chemical makeup system in INTEC-621 would replace the existing Chemical Makeup System in INTEC-601. The primary purpose of the chemical makeup system is to make and deliver batch solutions of chemicals. The system mixes powder and liquid chemicals with demineralized water in a mixing vessel, then pumps it through pipes to the point of use. In addition, part of the chemical makeup system provides a path for the delivery of bulk chemicals from INTEC-621 to the point of use. The delivery points for the use of both batch and bulk chemicals is INTEC-637, -604, and –659. Engineers chose INTEC-621 as the best location for the new Chemical Makeup System. Workers would install a new 1.5-inch line from INTEC-621 to connect with existing piping to INTEC-604 and INTEC-659 for the delivery of both bulk and batch chemicals.

The cost of deactivating the INTEC-601 Complex, by grouting in-place, is between $30-45M and would take between four and six years to complete.

2.1.1.2 Deactivate to Ground Level and Grout In-Place (Alternative 1b)

The sub-alternative to deactivate to ground level would consist of removing the above-grade facilities down to ground level. Workers would place the above-grade materials (superstructure and equipment) in below-grade cells or in boxes and ship to an approved storage and disposal facility. The "End State" of the facility would be a series of underground vaults filled with contaminated equipment and grout and a protective cover constructed over the footprint of the buildings. Deactivation activities would follow a similar sequence as discussed in Alternative 1a. However, workers would demolish the superstructure to ground level. Post-deactivation activities would be similar to the previously described sub-alternative, Alternative 1a.

DOE would send most of the contaminated above-grade material to an approved storage and disposal facility such as the RWMC. The below-grade portions of the INTEC-601 Complex lack the space to dispose of the above-grade material. Dismantling the above-grade material to ground level would incur additional risks such as an increase in the quantity of waste (solid and liquid) and radiation dose to workers. This sub-alternative would generate an estimated 100,000 gallons of decontamination solution. In addition, workers would be required to enter each cell and cut off and/or remove piping and vessels that extend above-grade level exposing workers to radiation. In addition, during the deactivation process, workers would be required to remove the upper portion of each cell, leaving an open, exposed source of radiation. This open radiation source would remain until workers could fill the remaining parts of each cell with grout.

LMITCO estimates the cost of dismantling the facilities to ground level at $394 million. This does not include the cost of handling and storage (Waite 1998a).

2.1.1.3 Deactivate to PM Level and Leave in an Interim State (Alternative 1c)

The sub-alternative to deactivate to an interim state consists of dismantling the INTEC-601 Complex superstructure to the PM level, placing it on the PM level, closing the RCRA Units to a **performance standard base**, and placing a membrane over the entire structure. Post-deactivation activities would include Surveillance and Maintenance (S&M) to ensure that radioactive and hazardous constitutes are not released to the environment. The estimated cost to deactivate the INTEC-601 Complex to this interim state is $16 M. In addition, deactivating to an interim state would continue to require S&M activities at an estimated cost of $2 M per year. DOE would evaluate disposition of the facility and could deactivate the facility at a future date.

2.1.2 Sub Alternative for Deactivation the INTEC-603 Complex

2.1.2.1 Deactivate to Ground Level and Grout In-Place (Alternative 1d)

Deactivation Activities – The proposed action would deactivate the underwater fuel storage basins, the FRSF, in INTEC-603, and demolish or otherwise dispose of all support systems and building structures associated with the basins and not needed for the IFSF. Deactivation activities would grout in-place the following areas within INTEC-603:

- North, South, and Middle basins
- Transfer Canal
- Transfer Stations
- Fuel Element Cutting Facility Hot Cell.

A new, but smaller truck bay would replace the existing North/South Truck Bay. In addition, workers would dismantle the Demineralizer and Regeneration Room (Old Ion Exchange Room), Basin Filter (Sand Filter) area, and New Ion Exchange area to grade-level.

There are four other buildings associated with INTEC-603: INTEC-626, INTEC-648, INTEC-1677, and INTEC-764. INTEC-626 contains offices, lunchroom, and a change room. INTEC-764 is an underground vault that houses the valves for VES-SFE-126 and VES-SFE-126 (Liquid Waste Collection

Tank). INTEC-1677 is a new above-grade building associated with VES-SFE-126. INTEC-648 is associated with the underground tank vault containing VES-SFE-106, the Solid Waste Collection Tank. Workers would deactivate and close the INTEC-648 building, INTEC-648 Valve Pit, and the VES-SFE-106 (the Solid Waste Collection Tank) under **interim status** in accordance with RCRA requirements. The other buildings, INTEC-626, INTEC-1677, and INTEC-764 would remain in service. In addition, the other parts of INTEC-603, the IFSF, and the East-West Truck Bay would remain in service. Before deactivation activities can begin, DOE would have to remove all the fuel from the basins. The current schedule calls for this to be complete by the end of the fiscal year 2000 (see Section 1.2.5).

Deactivation would isolate or reroute the building utilities, remove or demolish all equipment and piping, demolish the building roof, walls, and structural steel framing; placing materials in the basins. Construction workers would then fill the basins and vaults with grout.

Decontaminate, clean, remove, dismantle, or modify:

- ***Sand filters***
- ***Old and new ion exchange systems***
- ***Propane generator***
- ***Steam and condensate piping***
- ***Telephone board***
- ***Utility piping***
- ***Voice paging and evacuation systems***
- ***North Transfer Station***
- ***Sterilzer***
- ***Water treatment system***
- ***Electrical system***

Radiological workers would survey process equipment in relatively non-contaminated above-grade areas for radioactive contamination. Workers would place contaminated equipment or material in below-grade areas. Following radiation surveys and hot-spot stabilization with fixatives, construction workers would dismantle and size the roof and walls using a backhoe with a crushing and shear jaw attachment or similar equipment. The roofing and walls consist of transite siding containing asbestos or precast pumice blocks. The asbestos materials in the roof and siding are intact and nonfriable. Workers using backhoes would place debris from walls, roof, and superstructure in the below-grade areas. The application of water or other dust suppressants during the dismantling and sizing steps would control suspension of radioactive or asbestos particles. DOE would send the 1.5 million gallons of water in the basins to (a) the INTEC Tank Farm to flush and rinse the tanks, (b) the Process Equipment Evaporator (PEW), or (c) to a portable-water treatment system to clean.

Finally, workers would place a reinforced concrete cover over the basin areas. DOE would close the Solid Waste Collection Tank, VES-SFE-106, in accordance with RCRA, including placing a cap over the vessel and ancillary equipment. A new smaller passageway connecting INTEC-626 and the IFSF and East/West Truck Bay would replace the existing North/South Truck Bay. Grouting would minimize the generation of waste requiring treatment, storage, or disposal at other facilities. Workers would sequence deactivation activities similar to those described in Section 2.1.1.1.

Post-Deactivation Activities – In addition to INTEC-603, the INTEC contains several known hazardous substance sites that are undergoing review and corrective action under CERCLA. See Section, 2.1.1.1, "*Post-Deactivation Activities*," for discussion of DOE's plans related to Post-Deactivation Activities.

LMITCO estimates the cost of dismantling the facilities to ground level at $19 million.

2.2 Alternative 2: Deactivate and Remove INTEC-601 Complex and INTEC-603 Complex

2.2.1 INTEC-601 Complex

2.2.1.1 Deactivation Activities

Under this alternative DOE would decontaminate, dismantle, and remove all structures and equipment associated with INTEC-601, -627, and -640. This alternative would require

- Decontaminating or removing of radioactive areas within the facilities
- Dismantling of process equipment
- Demolition and removal of superstructure and foundation
- Waste packaging, removal, storage, transport, treatment, and disposal activities.

Radiological Control Technicians would survey all items. This alternative would size, properly contain, and dispose of contaminated material at the Radioactive Waste Management Complex (RWMC) or some other approved facility. Workers would then fill the excavated site with clean dirt. Clean material would be recycled or disposed of in an approved landfill.

During the deactivation process, procedures and controls such as component decontamination, particle stabilization, gloveboxes, and tents with filters would minimize emission of pollutants to the air. Additional ventilation supply and off-gas control systems would control particulate emissions.

In addition, DOE could choose airflow options 1a or 1b (see Section 2.4.1, page 16). However, only RCRA Closure Option 2b, "Closure to Performance Standards," is available with this alternative.

DOE estimates that this alternative would cost $666 million. In addition, DOE would incur additional S&M costs since this alternative would take longer to complete.

2.2.1.2 Post-Deactivation Activities

In addition to INTEC-601, -627, and -640, the INTEC contains several known hazardous substance release sites that are undergoing review and corrective action under CERCLA. See Section 2.1.1.1, *Post-Deactivation* for discussion of DOE's plans related to Post-Deactivation Activities.

2.2.2 INTEC-603

2.2.2.1 Deactivation Activities

Under this alternative DOE would decontaminate, dismantle, and remove all structures, equipment, and buildings associated with INTEC-603. This alternative would require similar action as those discussed in the previous section, Section 2.1.1.1. As in the proposed action, DOE would send the 1.5 million gallons of water in the basins to (a) the INTEC Tank Farm to flush and rinse the tanks, (b) the Process Equipment Evaporator (PEW), or (c) to a portable-water treatment system to clean. In addition to deactivation and removal activities, DOE would use the RCRA Closure Option 2b, "Closure to Performance Standards," to close the RCRA units in INTEC-603.

DOE estimates that this alternative would cost $200 million. In addition, DOE would incur additional S&M costs since this alternative would take longer to complete

2.2.2.2 Post-Deactivation Activities

This alternative would result in a site clean to RCRA Performance Base Standards. However, in addition to INTEC-603, the INTEC contains several known hazardous substance release sites that are undergoing review and corrective action under CERCLA. See Section 2.1.1.1, *Post-Deactivation* for discussion of DOE's plans related to Post-Deactivation Activities.

2.3 Alternative 3: No Action

This EA discusses two "No Action" alternatives: (1) Continue-the-activity-without-modification (*Continue*) and (2) Discontinue-the-ongoing-activity (*Discontinue*).

The *Continue*[9] No Action alternative gives a baseline from which to assess beneficial and detrimental effects associated with changes to the current activity resulting from the action alternatives. Likewise, the *Discontinue*[5] No Action alternative highlights the purpose of, need for, and the beneficial and detrimental effects of the ongoing activity (McCold and Saulsbury 1998).

This EA assumes that beyond 100 years, public access to the INTEC would continue to be restricted. The INEEL Land Use Plan (DOE 1996a) indicates that the INTEC would remain an industrial corridor with no public access for up to 100 years in the future.

This EA assumes that beyond 100 years, public access to the INTEC would continue to be restricted.

2.3.1 Continue "On-Going Operations" (3a)

Under this alternative of No Action, DOE would continue the present ongoing activities at INTEC-601, -603, -627, and -640. The INEEL discontinued reprocessing in 1992, not designating a future use for the facilities. However, these activities have left process equipment, vessels, and piping contaminated with highly radioactive process residues. Deactivating these facilities ensures that no reasonable possibility exists for future radiological exposure of humans or contamination of the environment. To assure the continued containment of highly radioactive process residues and control radiological contamination found in these facilities, S&M would continue at an estimated $3-4 M annually. These costs are necessary to (1) contain and prevent the spread of contamination, (2) repair equipment and leaking, broken, and malfunctioning lines, maintain the superstructure, and (3) keep monitoring equipment in working order. In addition, DOE would continue providing utilities (electricity, heat, water, etc.) to the facilities.

2.3.2 Discontinue "On-Going Operations" (3b)

Under this alternative of No Action, DOE would not deactivate or decontaminate any of the facilities. In addition, DOE would discontinue annual surveillance and maintenance activities.

9 For proposed changes to an ongoing activity, "no action" can mean continuing with the present course of action with no changes. It can also mean discontinuing the present course of action by phasing-out operations in the near future (see McCold and Saulsbury 1998).

2.4 Options for INTEC-601 Complex

2.4.1 Option 1 – Atmospheric Protection System

DOE used the INTEC-601 Complex for reprocessing spent nuclear fuel at the INTEC. Although these facilities have been not been used since 1992, the ventilation system connections to the INTEC APS remains operational for contamination control purposes. In general, ventilation air from these facilities is through a single HEPA filter bank. All other process vessels and equipment pass through a double HEPA filter bank. The off-gas from the INTEC-601 Complex combines with airflow from other INTEC systems and processes before release to the 250-ft INTEC main stack. Currently the airflow through the main stack is about 100,000-scfm.[10] When DOE deactivates the INTEC-601 Complex, the airflow would be reduced by roughly 50,000 scfm to about 50,000 scfm. Options when DOE deactivates the INTEC-601 Complex include (1) replacing the airflow or (2) reducing the airflow. Replacing the airflow would require new construction (see Section 2.1.1.1, "*New Construction*"), while not replacing the airflow would involve cutting the flow from INTEC-601 Complex.

Each of the alternatives, including the sub alternatives to the proposed action, require shutting down the airflow from the INTEC-601 Complex. The exceptions are the deactivation of the INTEC-603 Complex and the No Action alternatives. Furthermore, the airflow options described below require minor modification to the air permit-to-construct (PTC).

2.4.1.1 Replace Airflow (Option 1a)

In order to maintain the 100,000-scfm airflow to the main stack following deactivation of the INTEC-601 Complex, blowers and heaters would need to be purchased and housed in a new facility. This would require construction of a new building adjacent to the main stack (see Section 2.1.1.1, "*New Construction*"). This option would not have the operability problems associated with "reducing" the airflow (see following section). This option would cost about $816 K.

2.4.1.2 Reduce Airflow (Option 1b)

Reducing the airflow from 100,000 scfm to 50,000 scfm requires modifications to the main stack and monitoring systems in order to maintain the operability of several systems, such as the Liquid Effluent Treatment and Disposal Facility, PEW, and High Level Liquid Waste Evaporator. DOE estimates this option would cost about $1.1 M.

2.4.2 Option 2 – Resource Conservation and Recovery Act Closure Activities

RCRA requires that interim status units no longer needed must undergo closure. However, if it is demonstrated that not all contaminants can be practicably removed or decontaminated as required, then the system is closed in accordance with the closure and post-closure care requirements that apply to landfills [IDAPA 16.01.05.009 (40 CFR 265.310)] -- or closure to **Landfill Standards**. It is the intent of DOE to close these units to Performance Standards in accordance with a closure plan, Option 2b (see Section 2.4.2.2).

DOE would perform RCRA closures in accordance with a Closure Plan. RCRA closure of a tank system requires the removal or decontamination of all waste residues, structures and equipment contaminated with waste, and contaminated soils. If it is not practical to remove all the waste or decontaminate all the system components as required by RCRA, then DOE must close the tank system to landfill standards and

10 scfm = Standard cubic feet per meter.

perform post-closure care of the system. It is the intent of DOE to follow the regulations and attempt to attain a "Clean Closure" through decontamination efforts of the RCRA-regulated units.

In addition to the deactivation of INTEC-601, -603, -627, and -640, DOE will close the following RCRA units (see Section 4.4):

- INTEC-601 - WG/WH Cells Storage and Treatment Tanks. This interim status unit consists of four tanks (WH-100, WH-101, WG-100, and WG-101) with a maximum waste inventory of 18,000 gallons. These 4,500-gallon tanks, also known as the "Deep Tanks," are for the storage and treatment of mixed waste from cell floor and laboratory drains in buildings INTEC-601, INTEC-602 and other related facilities.
- INTEC-601/627 Container Storage. This container storage is located in the INTEC-601 D Cell and INTEC-627 Multi Curie Cell (MCC). DOE regulates these cells (or rooms) for maximum storage inventory of 160 gallons of mixed waste and the D Cell to store containers of **calcine** for future research. DOE does not currently use the MCC for calcine storage, nor has DOE stored calcine in the MCC.
- INTEC-640 Headend Holdup Storage Tanks. This interim status container-storage consists of three stainless-steel tanks (HW-100, HW-101, and HW-102) located in INTEC-640. DOE regulates the three 500-gallon tanks for storage of mixed waste. The tanks collected wastes from various sources including sumps, floor drains, safety shower drains, and heating and ventilation systems. Operators transfer wastes collected in these tanks to the West-side Waste Holdup System before transfer to the PEW system for treatment or to the INTEC Tank Farm for storage. HW-102 is still in service to collect floor drains. DOE did not use the other two tanks and workers have decontaminated them.
- There are four other buildings associated with INTEC-603: INTEC-626, INTEC-648, INTEC-1677, and INTEC-764. INTEC-764 is an underground vault that houses the valves for VES-SFE-126 and VES-SFE-126 (Liquid Waste Collection Tank). INTEC-648 is associated with the underground tank vault containing VES-SFE-106, the Solid Waste Collection Tank. Workers would deactivate and close the INTEC-648 building, INTEC-648 Valve Pit, and the VES-SFE-106 (the Solid Waste Collection Tank) under interim status in accordance with RCRA requirements.

Due to the deactivation activity, the INTEC-601 deep tanks (see above) would no longer be available to collect liquid laboratory waste from INTEC-602 and INTEC-684 and to transfer waste to INTEC-604. DOE would transfer these functions to other tanks. DOE would upgrade and permit existing tanks in INTEC-641 to accept liquid laboratory waste and transfer waste. Closure of the MCC would require permitting some other room for the storage of calcine.

DOE is preparing a RCRA Closure Plan to demonstrate how closure will occur. The Idaho Division of Environmental Quality must approve the plan before initiation of deactivation and closure activities.

2.4.2.1 Closure to Landfill Standards (Option 2a)

DOE proposes to close these units in accordance with the closure and post-closure care requirements that apply to landfills by encapsulating the RCRA-regulated vessels with grout. A RCRA cap would then be placed over these units upon completion of the building deactivation..

Implementation of the requirements imposed by a closure plan may ensure that a TSDF would not pose a future threat to human health or the environment after it is closed. Owners must close TSDFs in a manner that minimizes the need for care after closure. In addition, owners must control, minimize, or eliminate the escape of hazardous waste, hazardous **leachate**, or hazardous waste decomposition by-products; and meet the closure requirements for each type of unit. To accomplish this requirement, closure provides for the removal or decontamination of all waste residues, contaminated containment system components (liners, etc.), contaminated soils, and structures and equipment contaminated with waste, and the appropriate management of this waste. If the owner or operator demonstrates that not all contaminants can be practicably removed or decontaminated as required, then the owner or operator must close the TSDF and perform post-closure care of the system. Closure is in accordance with requirements that apply to landfills [IDAPA 16.01.05.009 (40 CFR 265.310)]. In addition, for the purposes of closure and post-closure, the regulations consider such a TSDF to be a landfill, and must meet the applicable regulatory requirements.

Closure to landfill standards is a possible option associated with any of the sub alternatives. However, DOE would delay the landfill closure option if they chose the sub alternative, "Deactivate to PM Level and Leave in an Interim State," Alternative 1c. If DOE chooses this alternative, then they would pursue other options, such as continued operation of RCRA Units.

2.4.2.2 Closure to Performance Standards (Option 2b)

It is the intent of the closures associated with INTEC-601, -627 and -640 to remove the hazardous waste, contaminants, and waste residue from these systems in accordance with a closure plan, subject to State approval. The closure plan would establish the most appropriate cleanup method or combination and/or sequence of methods to achieve the closure performance standard. The following are examples of preliminary closure methods and schedules that DOE plans to evaluate for these closures.

DOE would close the tank storage systems (INTEC-601 WG/WH Cells Storage and Treatment Tanks and the INTEC-640 Headend Holdup Storage Tanks) (see Figure 3) using standard decontamination methods to remove the mixed waste contamination. Decontamination methods for tanks and ancillary systems typically use extraction technologies such as water washing and spraying or abrasive blasting techniques. Workers would use a flushing process with an aqueous solution or high-pressure spray to remove the contaminants and decontaminate the tank systems. This decontamination method would be an iterative process followed by sampling of **rinsate** or swipe sampling to verify that the process met closure performance standards. Closure of the INTEC-601 WG/WH tanks (see Figure 3) and INTEC-640 is estimated to require 180 days to complete. However, it may not be possible to remove all mixed waste.

The INTEC-601/627 Container Storage area is located in the INTEC-601 D-Cell and INTEC-627 MCC (see Figure 3). DOE does not currently use the MCC for calcine storage, nor did DOE store calcine in the MCC. Therefore, DOE plans an administrative closure for this unit. The D-Cell currently stores a solid mixed waste calcine material. This calcine is stored in double containers that are intact, have not spilled, or caused any releases to the environment. Workers have conducted weekly and monthly inspections to verify the integrity of the calcine storage containers. Due to the documented absence of releases, it is likely that only minimal decontamination, if any, would be required for closure of this container storage room. DOE plans to use standard decontamination techniques for this room. Closure of the INTEC-601 D-Cell is anticipated to begin in 2003 after suitable storage for the calcine being stored in the unit is found and will likely require less than 180 days to complete. The administrative closure of the MCC would require 30 days to prepare paperwork for submittal to the State of Idaho.

Closure to "Performance Standard" is a possible option associated with any of the sub alternatives. However, DOE may delay this option if they choose the sub alternative, " Deactivate to PM Level and Leave in an Interim State," Alternative 1c. If DOE chooses this alternative then they may pursue another option, such as continue operation of RCRA Units.

2.5 Standard Mitigation

DOE would implement several **mitigative measures** for either of the action alternatives to reduce the impact to the environment, workers, and the public. These measures will become an integral part of the "Plan" to ensure that the overall effects of the action will not be significant (Table 2).

Table 2. Summary of Mitigative Measures.

- Air Emissions. DOE will limit fugitive dust emissions from deactivation and post-deactivation phases in compliance with Idaho Administrative Procedures Act (IDAPA) 16.01.01.650 and best management practices (EPA 1992). DOE will sequence closure events (e.g., sealing ductwork, slowly filling pipes and vessels with wet grout) to minimize radionuclide emissions due to resuspension. DOE will stabilize contaminated surfaces in the above ground portions of the facilities with fixatives before demolition. In addition, DOE will use HEPA-filtered enclosures to control radiation releases to the environment during the grouting process.
- Soil Disturbance. DOE will keep the disturbed area small and use erosion controls to minimize soil disturbance and loss. In addition, DOE will prepare a revegetation plan and/or a weed control plan.
- Water. DOE will adhere to a Storm Water Pollution Prevention Plan to protect surface waters. DOE will control and minimize water infiltration by building an asphalt apron around the buildings, causing rain water to run off away from the building and construction area.
- Biology/Ecology. DOE will relocate or remove (during the non-nesting season) nests of any migratory birds (excluding house sparrows, starlings, and pigeons) found nesting in the facility complexes.
- Cultural Resources. DOE will complete consultation as required by Section 106 of the National Historic Preservation Act before start of any activities associated with the proposed action. The proposed action may result in adverse impacts to historic INEEL properties. DOE will proceed with any "undertakings" in accordance with all of the substantive requirements resulting from consultation between the DOE-ID, the Idaho State Historic Preservation Officer (SHPO) and other interested parties. In the event workers discover materials, such as bones, chips or flakes, "arrowheads," or charcoal-stained soil during deactivation activities, DOE will invoke the INEEL Stop Work Authority. Invoking the Stop Work Authority will temporarily halt all excavation until the INEEL Cultural Resource Office provides a clearance or mitigative action plan.
- Noise. DOE will provide, in compliance with Occupational Noise Exposure, 29 CFR 1910.95, hearing protection to workers during deactivation if noise levels exceed 85 decibels.
- Waste. DOE will reduce the volume of waste by compaction, incineration in a permitted facility, or recycling of wastes to minimize the amount disposed or stored in hazardous or radioactive disposal and storage facilities. DOE will leave most of the waste materials in the lower levels of the facilities and grouted in-place, except for Alternative 1c and Alternative 2. DOE is preparing a RCRA Closure Plan to demonstrate how closure will occur. The Idaho Division of Environmental Quality must approve the plan before initiation of closure activities.
- Systems. DOE will reroute waste accumulation and transfer and chemical makeup systems. DOE will remove all fuel from INTEC-603 Basins and place the fuel in dry storage. DOE would modify airflow operations and equipment (see Section 2.4.1)
- Long-term. The CERCLA Program will assume post-deactivation cover maintenance and monitor groundwater consistent with the Record of Decision for the Remedial Investigation / Feasibility Study (RI/FS).

3 AFFECTED ENVIRONMENT

3.1 General Description

The INEEL is an 890 square mile DOE research facility located on the eastern Snake River Plain in southeastern Idaho (Figure 1). The FEIS describes, extensively, the physical and biological environment of the region in general and the INEEL in particular. DOE controls all land within the INEEL, and public access is restricted to public highways, DOE-sponsored tours, special use permits, and the Experimental Breeder Reactor I National Historic Landmark. DOE-ID also accommodates Shoshone-Bannock tribal member access to areas on the INEEL for religious purposes.

The INEEL is located mostly in Butte County, but also occupies portions of Bingham, Bonneville, Clark, and Jefferson counties. The 1990 census indicated the following populations, in parentheses for cities in the region: Idaho Falls (43,929), Pocatello (46,080), Blackfoot (9,646), Arco (1,016), and Atomic City (25) (DOC 1990). Approximately 127,554 persons reside within a 50-mi. radius of the INTEC. However, no permanent residents reside on the INEEL.

The INEEL and surrounding area are formally designated as an attainment area for any pollutant (e.g., SO_x, NO_x, PM-10) for which a national ambient air quality standard exists. It is further classified under the Clean Air Act as a **Prevention of Significant Deterioration** (PSD) Class II area, an area with reasonable or moderately good air quality that allows moderate industrial growth. Craters of the Moon Wilderness Area, which is approximately 15 miles from the INEEL is classified as a PSD Class I area, and is the nearest area to the INEEL where additional degradation of local air quality is severely restricted.

No endangered or threatened species of plants or animals are known to be resident to the INEEL (Beck 1997). However, the Bald Eagle (*Haliaeetus leucocephalus*), a threatened species, is a regular winter visitor to the north end of the INEEL. Biologists have occasionally observed Peregrine Falcons (*Falco peregrinus*) in remote areas of the INEEL during their spring migration. The U. S. Fish and Wildlife Service classifies the Peregrine Falcon as endangered. However, a petition to delist the species is under review. Several unsubstantiated sightings of the gray wolf (*Canis lupus*) on the periphery of the INEEL have been reported in the past few years. Although the FWS lists the gray wolf as an endangered species, the agency classifies wolves, in Idaho, as members of an experimental, non-essential population.

Surface water flows on the INEEL consist mainly of three streams draining intermountain valleys to the north and northwest of the site: the Big Lost River, the Little Lost River and Birch Creek. Flows from Birch Creek and the Little Lost River seldom reach the INEEL because of irrigation withdrawals upstream. The times when the Big Lost River and Birch Creek flow onto the INEEL are usually before the irrigation season, or during high water years. Flooding from the Big Lost River might occur onsite along the Big Lost River floodplain if high water in the Mackay Dam or the Big Lost River were coupled with a dam failure. Koslow and Van Haaften (1986) examined the consequences of a Mackay Dam failure during a seismic event, structural failure coincident with the 100- and 500-year recurrence interval floods, and during a **probable maximum flood**. The results from all dam failures studied indicate flooding would occur outside the banks of the Big Lost River from Mackay Dam to Test Area North, except within Box Canyon. The water velocity on the INEEL site, from these extreme events would range from 0.6 to 3.0 ft/s (Koslow and Van Haaften 1986). In addition, Koslow and Van Haaften (1986) estimated water depths outside the banks of the Big Lost River would range from 2 to 4 ft.

3.2 Specific Description

3.2.1 Background and Mission

The INTEC complex was one of the first areas developed at the INEEL. The original role of the INTEC was to recover uranium from the Materials Test Reactor spent fuel elements. DOE later expanded this role to include processing of spent fuel from other sources (DOE 1998). Construction of structures to support the processing role began in 1951 (DOE 1996a). DOE's initial plans were for an 82 acres facility. They later expanded it to its present size of 265 acres, 210 acres within a security perimeter fence and 55 acres outside of the fence (DOE 1998).

The mission of the INTEC is to receive and store spent nuclear fuels and radioactive wastes and treat and convert wastes. In addition, the mission is to develop new technologies for waste and waste management for the DOE in a cost-effective manner that protects the safety of INEEL employees, the public, and the environment. DOE employs about 1,104 people at the plant.

3.2.2 Landscape View

The INTEC spent fuel processing, storage, and support facilities of focus in the this proposal are about 0.5 mi. from the Big Lost river channel and about 11 ft above the riverbed elevation. Intermittent surface flow and the INEEL Diversion Dam, constructed in 1958 and enlarged in 1984, have effectively prevented flooding from the Big Lost river onto INEEL Sites. This control system protects the INTEC area from flooding by this control system.

Much of the area immediately surrounding the INTEC to the west and south is dominated by crested wheatgrass (*Agropyron cristatum*), a European **perennial** bunch grass seeded in disturbed areas. Many of the plants in the crest wheatgrass habitat have traditional and sacred significance to the Shoshone-Bannock Tribes. Native sagebrush-steppe vegetation, with some exceptions, dominates most of the area north and east of the INTEC.

The INTEC is located partially within the Big Lost River **floodplain** in the south-central portion of INEEL. It is underlain by 25 to 60 feet of **surficial** sediments made up of **alluvial** sandy to silty gravels, which rest on the irregular top surface of **basalt** lava flows. In some of the areas where the depth of basalt is greatest, a layer of clayey silt, up to 15 feet thick in places, occurs between the gravels and the basalt. **Eolian** (loess) or local stream activity deposited this layer before the Big Lost River began deposition of sandy gravels. A thin layer of silty soil overlies the gravels, partially derived from widespread loess deposits mixed with late **Pleistocene** alluvial sediments. Due to very flat terrain, with slopes of only a few feet per mile, and gravelly nature of the soils there is very little erosion hazard. The surficial sediments are **permeable**, well drained, and have a well-developed layer or layers of **caliche** (or hardpan) in the upper 10 to 15 feet. The most recent basalt lava flows underlying the gravels are several hundred thousand years old (Kuntz et al. 1994) and were erupted from vents to the south and southeast in the Axial Volcanic Zone of the eastern Snake River Plain.

A 30-ft layer of mixed sediments covers a deeper layer of underlying basalt. A grayish-brown gravelly silt loam, derived from loess mixed with alluvium from the Big Lost River, makes up the topsoil. Gravels occupy 50 to 75 percent of the surface area, and the erosion hazard is slight. The soil is moderately permeable, well drained, and generally non-alkaline. However, alkalinity increases with depth and hardpan zones may occur at depths from 20 in. to 20 ft. The EPA designated the Snake River Plain **Aquifer** a **sole-source aquifer** in 1991 (56 FR 50634, 1991) because groundwater supplies more than 50 percent of the drinking water consumed within the eastern Snake River Plain. In addition, an alternative drinking water source or combination of sources is not available.

The age and character of surficial sediments at INTEC also have implications for the flooding history of the site. The alluvial sandy gravels on which INTEC is sited are late Pleistocene in age (10,000 to 20,000 years) (Kuntz et. al. 1994) and show no evidence of major flooding since that time. In addition, Rathburn (1991) conducted a detailed study of sediments along the Big Lost River within the INEEL. That study showed that the sediments beneath the INTEC were deposited from an ~18,000-year-old glacial outburst flood during the breakup of the latest glacial period in southeastern Idaho. Sediments and soil patterns produced at the INTEC site during that deposition event have not been disturbed by channeling of the present Big Lost River. The **Holocene** (<10,000 year) floodplain of the Big Lost River, with its braided channels and cut-off meanders is confined to the low region between INTEC and Test Reactors Area (TRA), to the northwest of INTEC.

The Snake River Plain Aquifer underlies the INTEC at a depth of approximately 450-ft. DOE discharged liquid low-level radioactive and dilute chemical wastes to the subsurface through **injection wells** at the INTEC and the nearby Test Reactor Area between 1952 and 1984. Waste reduction, treatment, and disposal to surface evaporation and **percolation** ponds has since replaced liquid-waste disposal by injection. Water withdrawn from the aquifer near the INTEC for facility processes and drinking water meets the State of Idaho drinking water standards for all constituents.

A 1986 field study identified three perched water bodies that occur at depth from about 30 ft to 322 ft beneath the INTEC, and extend laterally as far as 3,600 ft. Overall, the chemical concentrations, shape and size of these perched water bodies have fluctuated over time in response to the volumes of water discharged to the INTEC percolation ponds (Irving 1993).

Archaeological sites left by Native American hunter-gatherers from 12,000-150 years ago dot the landscape surrounding the INTEC and continue to be important to the Shoshone-Bannock Tribes. Scientists have discovered evidence of well preserved early 20th century farming/homesteading near the INTEC. Within the fenced perimeter of the facility, archaeological and early historical sites are not likely to be preserved. However, a variety of structures located here did play an important role in the early development of processes and facilities for managing nuclear fuels and wastes.

A 1997 historic building inventory and assessment study identified 153 INTEC buildings, including trailers and temporary buildings. Of the 153 buildings identified and assessed, 38 were determined to be eligible for nomination to the National Register of Historic Places, including INTEC-601, INTEC-603, INTEC-627, and INTEC-640 (DOE 1998, Miller 1995). These facilities are located with the perimeter fence of the ICPPP. Buildings, roads, and walkways occupy the area within the fence. Little, if any natural habitat exists within the fence.

Intensive construction activities over the past four to five decades have likely obliterated any archaeological sites within the fenced perimeter at INTEC. However, the potential remains for inadvertent discovery of such sites during subsurface excavation work. Furthermore, intensive surveys in the area surrounding the INTEC perimeter have resulted in the recording of a variety of archaeological sites that may be eligible for nomination to the National Register of Historic Places.

3.2.3 Contaminant Inventory and Source Terms

Demmer (1996a, 1996b, 1996c, 1997) estimated inventories of radiological and non-radiological materials remaining in the INTEC-601 facilities and INTEC-603 basins (Table 3). Refer to Appendix A for detail information regarding inventories, source terms, and models used to estimate release fractions, doses, and cancer risk.

Table 3. Radiological Inventories and Source Terms in INTEC-601 Complex and INTECT-603 Complex.[a]

Nuclide	Source Term (in curies) INTEC-601	INTEC-603
Am-241	$2.63x10^{-1}$	b
Ba-137m	$3.73x10^{2}$	$2.37x10^{3}$
Ce-144	$6.83x10^{2}$	b
Cm-244	b	$3.40x10^{1}$
Co-60	b	$7.02x10^{-1}$
Cs-134	$9.91x10^{1}$	b
Cs-137	$3.86x10^{2}$	$2.49x10^{3}$
Eu-152	b	$5.74x10^{2}$
Eu-154	$7.69x10^{0}$	$3.23x10^{2}$
Eu-155	b	$3.13x10^{1}$
H-3	$1.44x10^{0}$	b
I-129	$1.83x10^{-2}$	b
Nb-94	b	$1.30x10^{0}$
Nb-95	$8.08x10^{1}$	b
Pm-147	$3.12x10^{2}$	b
Pu-238	$5.94x10^{0}$	$7.20xx10^{-1}$
Pu-239	$3.00x10^{-2}$	$2.26x10^{0}$
Pu-241	$2.79x10^{0}$	b
Ru-106	$5.87x10^{1}$	b
Rh-106	$5.87x10^{1}$	b
Sb-125	$4.30x10^{0}$	$1.00x10^{1}$
Sr-90	$3.84x10^{2}$	$8.71x10^{1}$
Te-125m	$1.67x10^{0}$	$2.50x10^{0}$
U-234	b	$3.03x10^{-1}$
Y-90	$3.84x10^{2}$	$8.71x10^{1}$
Zr-95	$3.79x10^{1}$	b

a. See Appendix A, page 58.
b. Not present

4 ENVIRONMENTAL CONSEQUENCES

This section describes the environmental consequences that may result from implementing the proposed action or one of the alternatives. Consequences or impacts can be either direct or indirect. Direct impacts occur from a simple stimulus and response relationship such as exposure to radionuclides results in a certain dose. Indirect impacts occur from secondary or higher-order relationships that act through intermediate sets of stimuli and responses such as toxic contamination of bird shell eggs through birds eating contaminated prey (Regier and Rapport 1978). A third type of impact, cumulative impacts are the incremental impact of a single project or action added to all other past, present, and reasonably foreseeable future actions.[11]

Sections 4.1, 0, and 4.3 discuss project-specific direct and indirect impacts. Section 4.5 discusses potential cumulative impacts from this project in relationship to other projects. Finally, Section 4.7 compares environmental consequences across alternatives.

4.1 Alternative 1: Deactivate and Leave In-Place the INTEC-601 Complex and INTEC-603 Complex

4.1.1 Air Resources

Deactivation Activities -- Staley (1998) estimates potential radionuclide emissions and associated doses resulting from deactivation activities. The release scenario assumes that some percentage (see Appendix A, page 58) of the remaining radionuclide inventory would be resuspended and released at ground level. Appendix A, Table 18 and Table 19 show the estimated radiological releases for the INTEC-601. The estimated releases and doses are conservative for the following reasons:

- controls such as temporary, HEPA-filtered enclosures would likely reduce emissions below those calculated herein;
- although deactivation operations would be carried out over several years, the entire radionuclide release is assumed to occur in a single year;

The calculated doses to the **maximum exposed individual** (MEI) (Table 4) are not much different than the 1996 dose from routine INTEC facility releases of 1.65×10^{-2} mrem, (DOE 1997). Across alternatives, doses to the MEI are not largely different from this routine dose (Table 4). In addition, doses to the MEI from all alternatives would be well below the NESHAP's 10-mrem-dose standard established by the Federal regulation, 40 CFR 61 Subpart H – "*National Emission Standards for Hazardous Air Pollutants*." Subpart H states that emissions of radionuclides to the ambient air from DOE facilities shall not exceed those amounts that would cause any member of the public to receive an effective dose equivalent of 10 mrem/yr. The actual dose from the INEEL is typically below 0.1 mrem/yr.

The calculated worker dose (Table 4) from all alternatives would be below the INEEL occupational dose limit of 500 mrem/worker/yr. In fact, worker doses would likely be less than those calculated. This is because the worker is assumed to be at the location of maximum exposure 8 hours/day, every work day

11 The Council on Environmental Quality's regulations for implementing the National Environmental Policy Act define cumulative effects as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-federal) or person undertakes such other actions (40 CFR § 1508.7).

Table 4. Dose Summary for INTEC-601 Complex and INTEC-603 Complex Sub Alternatives (Staley 1998).[a]

	Sub Alternatives			
	INTEC-601 Complex			INTEC-603 Complex
Receptor	1a	1b	1c	1d
MEI	$1.2x10^{-2}$	$8.4x10^{-2}$	$8.2x10^{-3}$	$8.7x10^{-2}$
Worker	$1.5x10^{1}$	$1.1x10^{2}$	$1.1x10^{1}$	$9.4x10^{1}$
Population	$4.3x10^{-2}$	$3.1x10^{-1}$	$2.97x10^{-2}$	$3.2x10^{-1}$

a. Dose in mrem/year for MEI and worker; person-rem for population.

for 50 years to receive the maximum inhalation dose and ground surface dose from deposited radionuclides. This is a highly unlikely scenario.

Doses to the population living within 50 miles of the INTEC (Table 4) would be low. Although the only dose standard is for the MEI (discussed above), the doses from these alternatives are well below those received from background sources of radiation in SE Idaho of about 350 mrem/person/yr. This is equivalent to 44,600 person-rem in the population of 127,554. For Alternative 1, calculated population doses are less than 0.0007% of the dose from background radiation.

Calculated releases of non-radioactive, hazardous contaminants would be, in most cases, well below applicable health-based emissions limits. The exception is cadmium, which could exceed the Emission Limit set by the State of Idaho. For cadmium and other carcinogens, modelers calculated one-year average concentrations at the MEI location on the INEEL boundary. All calculated concentrations were below Idaho's Acceptable Ambient Concentrations for Carcinogens (AACC s) (see Appendix A).

Among the subalternatives for deactivating INTEC-601, Alternative 1a would have the lowest and 1b the highest, air releases.

See Section 4.1.7 for a discussion of health effects associated with these doses.

External radiation estimated doses vary greatly across alternatives. Workers would receive the highest external radiation dose from Alternative 1b and the least from Alternatives 1a and 1c. Removal of the facility to the PM Level (Alternative 1a) would result in an estimated external radiation dose of 1.5-2.0 Man-rem to workers. Removal of the facilities to ground level (Alternative 1b) would result in an estimated external radiation dose of 150-200 Man-rem to workers. Removal of the facilities to the PM level and leaving the rest of the facility in an Interim State (Alternative 1c) would result in an estimated radiation dose of 1.5-2.0 Man-rem to workers. Removal of the INTEC-603 Complex to ground level would result in an estimated external radiation dose of an estimate 20 Man-rem to workers.

Post-Deactivation Activities – No Post-Deactivation air emission or associated impacts are expected.

4.1.2 Geology and Soil Resources

Deactivation Effects – The Deactivation and Grouting In-Place alternative would only have minor, localized impacts on the geology of the INEEL site. Deactivation activities would be of short duration and workers would reduce soil loss by keeping the areas of surface disturbance small. In addition, workers would reduce soil loss by using engineering practices such as dust suppression, storm water runoff-control including sediment catchment basins, slope stability, and soil stockpiling with wind erosion protection.

Post-Deactivation Effects – **Seismic** and volcanic hazards for the INTEC area have been assessed (Woodward-Clyde Federal Services 1996; Hackett and Smith 1994). Ground motions to be expected are probably incapable of cracking or damaging the subsurface concrete monoliths resulting from the deactivation-in-place alternative. Probabilities of inundation of the area by basalt lava flows are in the range of 10^{-6} per year and volcanism does not pose a threat to the deactivation-in-place alternative. Even if the area were covered by basalt lava flow in the distant future, significant heating of the ground would extend for only a meter or so beneath the present surface. This would not cause significant damage to the monoliths or increase the potential for release of the very low levels of contamination remaining in the structures.

The large grain size of the sediments (over 50% gravel), the unsaturated conditions of the sediments, the **high blow counts**, and the high seismic **shear wave velocity** (Geovision Geophysical Services 1997) preclude the potential for soil liquefaction during an earthquake. Data from Seed et al. (1983) show that soils will not liquefy when they have standard penetration test (SPT) blow counts greater than 35 blows per foot. Extensive drilling and geotechnical investigations at INTEC (Northern Engineering and Testing 1987) have shown that most SPT counts per foot in sandy gravels exceed 35 and reach values as high as 200 to 300 (Smith 1998, Golder Associates 1992, Dames and Moore 1976, Dames and Moore 1977 Northern Engineering and Testing 1987). In addition, data from numerous sites throughout the world (Seed et al. 1983, Kayen 1992) show that liquefaction does not occur in sediments or soils which have seismic shear wave velocities of greater than about 300 meters/sec. Shear wave velocity measurements made at several INTEC sites show that sediments there typically have shear wave velocities of 300 to 600 meters/sec (Smith 1998, Dames and Moore 1976, Dames and Moore 1977, EG&G 1984, Northern Engineering and Testing 1987, Golder Associates 1992).

The large grain size, the unsaturated conditions, the high blow counts, and the high shear wave velocities also preclude the potential for consolidation of the soils under heavy loads. Consolidation is the long-term **subsidence** of the ground due to gradual forcing of water from the soil pores due to increased load of a building or a structure. It can be a significant problem in some soils because it continues for months to years and can result in damaging differential movements of structures. However, even if INTEC soils were permanently saturated (which they are not) consolidation would not occur because the grain size is so large (sands and gravels) that no pore pressure can be developed by building loads. There would be some immediate settling of the structure as the building is filled with grout, but it would be small, probably less than 1 inch (Jensen 1997, Fritz 1995, Matzen 1995). This settling would be due to slight compression of the soil particles and/or to slight bending of basalt layers under the increased load, and poses no threat of soil instability or long-term subsidence.

The deactivation and post-deactivation impacts described above would also apply to the other deactivation alternatives: Deactivate to Ground Level (INTEC-601 or INTEC-603) and Grout In-Place (Alternatives 1b and 1d) and Deactivate to PM Level (INTEC-601), Grout In-Place, and Leave in Interim Status (INTEC-601) (Alternative 1c). DOE does not expect impacts to geologic or soil resources from these alternatives.

4.1.3 Water Resources

Deactivation Effects – The Deactivation In-Place Alternative would not have any direct impacts to the Big or Little Lost Rivers or Birch Creek. The distance from INTEC-601 Complex to the Big Lost River channel, local topography between the respective buildings and the channel, infiltration rates of the surface alluvium and basalt, and intermittent flows in the Big Lost River channel all suggest that, under normal flows, the Big Lost River would not have any effect on the buildings -- nor the buildings on the Big Lost River. During deactivation activities, adhering to a Storm Water Pollution Protection Plan (see Section 5.1) would control water and wind erosion.

Impacts from contaminants leaching to the soil surrounding INTEC-601 Complex are unlikely because the methods of filling the below-grade portion of the buildings would leave the above-grade superstructure, including the roof, intact until the below-grade portion is filled. In addition, an asphalt apron around the facility would reduce infiltration of water.

Post-Deactivation Effects – Normal flows in the Big Lost River would not have any impact on INTEC-601 Complex or solid concrete block. Koslow and Van Haaften (1986) evaluated the potential consequences of a maximum flood coupled with a MacKay Dam failure. DOE estimates that the probability of an occurrence for this combined event is between 10^{-6} to 10^{-8} per year or 1 in 1,000,000 to 1 in 100,000,000. This event would result in floodwater within the INTEC-controlled area up to about 4,916.6 ft above mean sea level (LMITCO 1995). The elevation of INTEC-601 Complex is about 4,916 ft. However, low water velocities and shallow water depths resulting from this flood would not be sufficient to cause serious erosion damage to backfill around buildings (see Section 3). Therefore it is unlikely that any damage to the concrete-encased buildings or leakage of radionuclide or hazardous chemicals would occur. Hence, DOE expects no discernible impacts on regional-surface water quality from the Deactivation in-place alternative.

The deactivation and post-deactivation impacts described above would also apply to the other deactivation alternatives: Deactivate to Ground Level (INTEC-601 or INTEC-603) and Grout In-Place (Alternatives 1b and 1d) and Deactivate to PM Level (INTEC-601), Grout In-Place, and Leave in Interim Status (INTEC-601) (Alternative 1c).

4.1.4 Biological Resources

Deactivation Effects – The Grout-in-Place alternatives would not have any direct, negative, impacts on the flora, fauna, endangered species, or ecology of the INEEL site. Closure activities would not affect the existing environment outside the INTEC fence. Over the years, DOE has disturbed the area within the fence by constructing and paving roads and erecting buildings. Because the area of consideration and the environmental consequences of this action are similar to those for Closure of the Waste Calcining Facility (DOE/EA-149), the determination that a biological assessment is not needed (Reynolds 1998) still applies.

Post-Deactivation Activities – Long-term impacts to biological resources from the Grout In-Place alternative would consist of continued lost productivity from the lands covered by the cap, about 1 acre for INTEC-601 Complex and 0.6 acres for INTEC-603 Complex. The potential exists for small animals (birds, mammals, etc.) to have access to deactivated buildings under alternative 1c.

The deactivation and post-deactivation impacts described above would also apply to the other deactivation alternatives: Deactivate to Ground Level (INTEC-601 or INTEC-603) and Grout In-Place (Alternatives 1b and 1d) and Deactivate to PM Level (INTEC-601), Grout In-Place, and Leave in Interim Status (INTEC-601) (Alternative 1c).

4.1.5 Cultural Resources

> ***Deactivation would proceed only in accordance with all of the substantive requirements . . .***

Deactivation Effects – The Deactivation-In-Place alternative would destroy structures or portions of structures that are eligible for nomination to the National Register of Historic Places (National Register). An inventory and historic significance assessment study of INEEL buildings was conducted in 1997. This study identified INTEC-601 and INTEC-603 as individually eligible, INTEC-627 and INTEC-640 as contributing elements in a potential historic district through their important and unique role in the nation's reactor fuel reprocessing program (DOE 1998). It is unlikely that any workers would directly impact any archaeological resources by activities concentrated within the fenced INTEC perimeter.

Deactivation would proceed only in accordance with all of the substantive requirements resulting from consultation between the DOE-ID, the Idaho State Historic Preservation Office (SHPO), and other interested parties. The National Historic Preservation Act's Section 106 requires consultation before initiation of any of the activities (see Section 6, page 48). In the event materials, such as bones, chips or flakes, "arrowheads," or charcoal-stained soil are discovered during deactivation activities, the INEEL Stop Work Authority will be invoked. Invoking the Stop Work Authority will temporarily halt all excavation until the INEEL Cultural Resource Office provides a clearance or mitigative action plan.

Post-Deactivation Effects – LMITCO's Cultural Resource Management Office does not expect long-term impacts to cultural resources, except the permanent occupation of the site by remnants of the monoliths.

The deactivation and post-deactivation impacts described above would also apply to the other deactivation alternatives: Deactivate to Ground Level (INTEC-601 or INTEC-603) and Grout In-Place (Alternatives 1b and 1d) and Deactivate to PM Level (INTEC-601), Grout In-Place, and Leave in Interim Status (INTEC-601) (Alternative 1c).

4.1.6 Land Use and Visual Resources

Deactivation Effects – The INTEC-601 Complex is located within the INTEC fence, an area that has been highly disturbed by paving and building. Deactivation activities such as grouting would not affect the current land use or visual resources near the INTEC.

Post-Deactivation Effects – Most of the INEEL is open space that DOE has not designated for specific uses. Facilities and operations use about 2 percent of the total INEEL site, primarily for nuclear energy research and waste management and environmental restoration support operations. Public access to the INTEC and most other facility areas is restricted. The INEEL Land Use Plan (DOE 1996a) indicates that the INTEC would remain an industrial area with no public access for 100 years in the future. Land Use plans and policies for the INTEC and other INEEL facilities identify continued energy research, waste management and environmental restoration as the major INEEL business activities through the foreseeable future (DOE 1996a). The Grout In-Place above Ground Level alternative is included in the waste management and environmental restoration missions of the INEEL. In addition, it is consistent with current and foreseeable land use plans.

Long distance views are of the INEEL's rolling hills, buttes and volcanic outcrops; and of the Lemhi, Lost River and Bitterroot mountain ranges that border the INEEL on the north and west. The INTEC is located on a relatively flat area surrounded by undeveloped land that supports shrub-steppe grassland vegetation. However, 20-foot changes in elevation are common on the INEEL and even occur near the INTEC. Other INEEL industrial facilities visible from the INTEC include the Central Facilities Area, Test Reactor Area, Naval Reactors Facility, and Power Burst Facility. The deactivation of the INTEC-601 Complex would leave a 20- to 25-foot high monolith above ground level, within the INTEC fence. In the future, closure of the INTEC complex will likely involve one or more CERCLA caps designed to reduce the release of contamination. A 20- to 25-foot high monolith would result in a higher CERCLA cap over the INTEC-601 Complex and INTEC-603 Complex.

The deactivation and post-deactivation impacts described above would also apply to the other deactivation alternatives: Deactivate to Ground Level (INTEC-601 or INTEC-603) and Grout In-Place (Alternatives 1b and 1d) and Deactivate to PM Level (INTEC-601), Grout In-Place, and Leave in Interim Status (INTEC-601) (Alternative 1c). However, the Grout In-Place at Ground Level alternative would not leave an elevated monolith, thus the CERCLA cap would not need to be as high.

4.1.7 Health Effects

The purpose of this section is to present the potential health effects to both workers and the public that would result from exposure to hazardous and radioactive material.[12] Modelers evaluated the airborne and external exposure pathways for deactivation activities (see Appendix A, page 58). Health effects associated with the external exposure and groundwater ingestion pathways are associated with post-deactivation activities (see Appendix B, page 66). For the ingestion pathway, the 100-year future occupational and residential exposures scenarios were evaluated using the refined risk assessment model for those radionuclides where the risks were greater than the lower NCP target risk range of 1×10^{-6}. Potential risks and hazards associated with the contaminant of potential concern (COPC) at the INTEC-601 Complex, such as I-129, Sm-151, Sr-90, were assessed for occupational or worker exposure and residential or public receptors. Because a portion of the INTEC-601 complex would be grouted above grade, the risk from external exposure was calculated using Microshield."

Deactivation Activities – Considering all alternatives, the maximum increased lifetime risk to the MEI of developing a fatal cancer (Alternative 1b) would be 4.2×10^{-8}, or 1 in 24 million (Table 5). This rate can be compared to National Cancer Institute (NCI) data from Idaho of about 1 in 13 cancer deaths over a 50 year period, from all other sources based on 1987-1991 data from Idaho (NCI 1994).

Across alternatives, the maximum increased lifetime risk of cancer for the worker 100-m distant would be 4.4×10^{-5} or 1 in 23,000 (Table 5). Decisionmakers can compare this risk to the 1 in 13 risk from all other sources (NCI 1994).

Table 5. Cancer Risk Summary for INTEC-601 Complex and INTEC-603 Complex Sub Alternatives (Staley 1998).

	Sub Alternatives			
	INTEC-601 Complex			INTEC-603 Complex
Receptor	1a	1b	1c	1d
MEI	6.0×10^{-9}	4.2×10^{-8}	4.1×10^{-9}	4.3×10^{-8}
Worker	6.2×10^{-6}	4.4×10^{-5}	4.2×10^{-6}	3.8×10^{-5}
Population	2.2×10^{-5}	1.5×10^{-4}	1.5×10^{-5}	1.6×10^{-4}

12 Radiation exposure and its consequences are topics of interest to the public near nuclear facilities. For this reason, this EA places more emphasis on the consequences of exposure to radiation than on other topics, although the effects of radiation exposure evaluated in this EA are small. Refer to "Helpful Information for the General Reader" for an explanation on the measurement of radiation and the different sources of radiation (see page ii).

In the affected population of 127,554 persons, the increased lifetime risk of an individual developing a fatal cancer as a results of INTEC-601 deactivation would be about 1 in 850,000,000 or less. In this same population each individual has a 1 in 13 risk of a fatal cancer over a 50 year lifetime from all other sources, based on 1987-1991 NCI data from Idaho (NCI 1994). In other words, the additional cancer risk posed by the proposed project would not significantly contribute to, nor be discernable from, the "normal" cancer fatality rate.

Post-Deactivation Activities – Based on the screening analysis peak groundwater concentrations of contaminants only groundwater ingestion from exposures to I-129, Sm-151, and Sr-90 presented a risk greater than the $1x10^{-6}$ lower limit of the National Oil and Hazardous Substance Pollution Contingency Plan (NCP) target for allowable risk range (see Appendix B) (Stepan and McCarthy 1997 and 1998). Risks from the other radionuclides were below the lower NCP target, $1x10^{-6}$ (Appendix B). Using the refined risk assessment, risks from I-129 and Sr-90 would also be less than the lower limit of the NCP target risk range, $1x10^{-6}$, and Sm-151 would be within the NCP target risk range of $1x10^{-4}$ to $1x10^{-6}$. The total cancer risk, for alternatives 1a and 1b (INTEC-601) and alternative 1d (INTEC-603), due to groundwater ingestion from these three radionuclides would be $3x10^{-6}$ and $4x10^{-5}$, respectively (Table 6). In addition, non-carcinogenic risks from metal ingestion were less than the hazard index of 1. Therefore, the radionuclides and hazardous constituents remaining in INTEC-601 and INTEC-603 complex would not pose an unacceptable risk to human health or the environment during the post-deactivation period, except for Alternative 1c (see next paragraph).

The post deactivation risk associated with leaving the facility in long-term interim status (Alternative 1c) would be similar to those described above for deactivating to the PM Level plus those described in the No Action Alternative (see Section 4.3.1).

4.1.8 Waste Management

Deactivating to the PM Level and grouting in-place (Alternative 1a) generates the least amount of waste. Grouting in-place would essentially encase all of the contents of the INTEC-601 Complex, including the radioactive and hazardous substances listed in Table 7 in a solid concrete block. Following capping, the deactivated INTEC-601 Complex would be managed in accordance with the post-closure care requirements that apply to RCRA landfills (40 CFR 265.310). The total estimated encased volume of the INTEC-601 Complex (Alternatives 1a and 1b) and INTEC-603 Complex (Alternative 1d) and there contents is 1,106,184 ft^3, 170.840 ft^3, and 562,065 ft^3 respectively. Deactivation activities for the "Ground

Table 6. Cancer risks for radionuclides in the 100-year residential groundwater ingestion pathway, based on the refined risk analysis.[a]

Radionuclide		Alternative 1a	Alternative 1b	Alternative 1c[b]	Alternative 1d
I-129		4x10-7	3x10-7	-	c
Sm-151		2x10-6	2x10-6	-	c
Sr-90		3x10-7	c	-	c
	Total	3x10-6	3x10-6	-	c
Nb-94		c	c	-	$2x10^{-6}$
Pu-239		c	c	-	$4x10^{-5}$
Sr-90		c	c	-	$8x10^{-7}$
U-234		c	c	-	$1x10^{-6}$
U-235		c	c	-	$5x10^{-7}$
	Total			-	$4x10^{-5}$

a. Alternative 1a— Deactivate to PM Level and Grout INTEC-601 In-Place.
Alternative 1b— Deactivate to Ground Level and Grout INTEC-601 In-Place.
Alternative 1d— Deactivate to Ground Level and Grout INTEC-603 In-Place.
b. There is no post deactivation risk associated with Alternative 1c.
c. Radionuclide not present in refined risk assessment.

Table 7. Potential Waste Streams at the INTEC-601 Complex and INTEC-603 Complex.[a]

Alternative and Sub Alternatives	Asbestos (ft)	Water (gal)	Lead (lbs)	LLW (ft^3)	HLW (ft^3)	Mixed Waste (ft^3)	Industrial Waste (ft^3)	Liquid Waste (gal.)
				INTEC-601 Complex				
Deactivate to PM Level and Grout In-Place (1a)	400	-	5,000	-	-	-	2,700	55,000
Deactivate to Ground Level and Grout In-Place (1b)	1,000	-	10,000	339,588	135,832	203,748	500	100,000[b]
Deactivate to PM Level and leave in Interim State (1c)	800	50,000	-	-	-	-	-	55,000
Total Removal	1,500	-		653,093	261,236	391,855	20,000	150,000[b]
				INTEC-603 Complex				
Deactivate to Ground Level and Grout in-Place (1d)	-	1.5 M	96,000	-	-	-	100	100,000[b]
Total Removal	1,000[c]	1.5 M	96,000	214,000		:	10,(	150,000[b]

a. Waite 1998b.
b. INTEC-601 and INTEC-603 combined.
c. Plus 21,330 cubic feet

Level" alternative (Alternative 1b) would decrease the amount of waste left in place, but would increase the waste disposed of at the RWMC or other similar facility. Potential waste streams associated with deactivation activities for the "Interim State" alternative (Alternative 1c) generate only a few cubic feet of waste material. Other wastes would be associated with the RCRA Closure such as decontamination liquid, etc. Workers would generate up to 100,000 gallons of liquid waste while decontaminating INTEC-601 and INTEC-603 complexes before grouting the facilities in place (Table 7).

4.2 Alternative 2: Deactivate and Remove INTEC-601 Complex and INTEC-603 Complex

This EA discusses the impacts from deactivation and removal activities in the following sections. No post-deactivation or post-removal impacts are expected.

4.2.1 Air Resources

Deactivation Activities – The calculated doses to the MEI (Table 8) are not much different than the 1996 dose from routine INTEC facility releases of 1.65×10^{-2} mrem (DOE 1997). In addition, doses to the MEI are well below the NESHAP's 10-mrem-dose standard established by the Federal regulations, 40 CFR 61The dose to the MEI from the INTEC-601 Complex deactivation is not much different from this routine dose. The doses can also be compared further to the dose limit established by the Federal regulations, 40 CFR 61 Subpart H – "*National Emission Standards for Hazardous Air Pollutants*." Subpart H states that emissions of radionuclides to the ambient air from DOE facilities shall not exceed those amounts that would cause any member of the public to receive an EDE of 10 mrem/yr. The doses to the MEI from Alternative 2 would be well below this standard.

The calculated worker dose (Table 8) from alternative 2 would be below the INEEL occupational dose limit of 500 mrem/worker/yr. In fact, worker doses would likely be less than that calculated. This is because the worker is assumed to be at the location of maximum exposure 8 hours/day, every work day

Table 8. Dose Summary for INTEC-601 Complex and INTEC-603 Complex Alternaitve 2.[a]

	Alternative 2	
Receptor	INTEC-601 Complex	INTEC-603 Complex
MEI	7.1×10^{-2}	2.7×10^{-1}
Worker	9.2×10^{1}	2.9×10^{2}
Population	2.6×10^{-1}	9.9×10^{-1}

a. Dose in mrem/yr. for MEI and worker; person-rem for population.

for 50 years to receive the maximum inhalation dose and ground surface dose from deposited radionuclides. This is a highly unlikely scenario.

Doses to the population living within 50 miles of the INTEC (Table 8) would be low. Although the only dose standard is for the MEI (discussed above), the doses from this alternative are well below those received from background sources of radiation in SE Idaho of about 350 mrem/person/yr. This is equivalent to 44,600 person-rem in the population of 127,554. For Alternative 2, calculated population doses for INTEC-601 Complex and INTEC-603 Complex are less than 0.0006 and 0.0025 percent, respectively, of the dose from background radiation.

Removal of the INTEC-601 and INTEC-603 complexes to ground level would result in an estimated external radiation dose of 750 Man-rem and 50 Man-rem to workers.

4.2.2 Geology and Soil Resources

The Removal Alternative would only have minor, localized impacts on the geology of the INEEL site. Direct impacts to geologic resources at the INEEL site would be associated with disturbing or extracting surface deposits to fill the excavations left by removing the dismantled below-grade structures. A secondary impact to geology from deactivation and filling activities would be the potential for increased soil erosion. In the short-term, deactivation and filling activities would cause some soil loss. However, these activities would be of short duration. Workers would reduce soil loss by keeping the areas of surface disturbance small and by utilizing engineering practices such as storm water run-off control including sediment catchment basins, slope stability and soil stockpiling with wind erosion protection. This alternative would leave the decontaminated below-grade concrete footings, foundations, and floors in place.

Another impact to geology from deactivation activities involving removal would be the potential for increased soil erosion. In the short-term, DOE expects some soil loss. However, these activities would be of short duration. Workers would minimize soil loss by keeping the areas of surface disturbance small and by using engineering practices such as storm water run-off control, including sediment catchment basins, slope stability, and soil stockpiling with wind erosion protection.

4.2.3 Water Resources

The Removal Alternative would potentially have only minor, localized impacts on the water resources at the INEEL site. Direct impacts to water resources at the INEEL site would be associated with disturbing or extracting surface deposits to fill the excavations resulting from the removal of the dismantled below-grade structures.

This alternative would leave the decontaminated below-grade concrete footings, foundations, and floors in place. Workers may drill or fractured the floors to facilitate storm water drainage and the below-grade area backfilled with clean soil. DOE does not expect impacts to groundwater from this alternative. However, they acknowledge the greater potential for leakage or spills and subsequent contaminant transport to the groundwater for this alternative because it would generate a relatively large volume of liquid waste from decontamination fluid. DOE would treat the decontamination fluid as discussed in Section ????.

4.2.4 Biological Resources

Measurable impacts to flora and fauna, including Threatened, Endangered, or Species of Special Concern, from the this alternative during removal are unlikely. Some of the common but less mobile fauna occupying the area from which borrow material would be excavated to fill the voids remaining after removal of structures would likely be impacted. Populations would likely recover following proper rehabilitation of the borrow source13. Because the area of consideration and the environmental consequences of this action are similar to those for Closure of the Waste Calcining Facility (DOE/EA-149), the determination that a biological assessment is not needed (Reynolds 1998) still applies.

4.2.5 Cultural Resources

See also Section 4.1.5, "*Cultural Resources*."

4.2.6 Land Use and Visual Resources

Deactivating and removing the INTEC-601 and INTEC-603 complexes is consistent with the waste management and environmental restoration missions of the INEEL and would not result in any short-term changes in land use. Following removal, the below-grade areas would be backfilled to restore the sites to a grade, contour, and visual characteristics consistent with its surroundings.

4.2.7 Health Effects

See 4.1.7 for purpose of presenting the potential health effects. INTEC-601 Complex and INTEC-603 Complex would require decontaminating or stabilizing radioactive areas, dismantling process equipment and waste packaging, removing, transporting, treating and disposing activities within the INTEC-601 and INTEC-603 complexes. The dose to the worker and public from waste transportation, treatment, and disposal were not calculated, but are expected to be small.

The maximum increased lifetime risk to the MEI of developing a fatal cancer from implementing this alternative would be 1.3×10^{-7} or 1 in 7.7 million (INTEC-603 Complex) (Table 9). This rate can be compared to NCI 1987 to 1991 data from Idaho of about 1 in 13 over a 50 year period, from all other sources).

For this alternative, the maximum increased lifetime risk of fatal cancer for the worker 100 m distant from INTEC-601 would be about 1.2×10^{-4} or 1 in 8,300 (INTEC-603 Complex) (Table 9), compared to the risk from all other sources of 1 in 13.

In the affected population of 127, 554 persons, the maximum average increased lifetime risk of an individual developing a fatal cancer as a result of this action would be about 1 in 225 million. In this

Table 9. Cancer Risk Summary for INTEC-601 Complex and INTEC-603 Complex Alternaitve 2.

	Alternative 2	
Receptor	**INTEC-601 Complex**	**INTEC-603 Complex**
MEI	3.6×10^{-8}	1.3×10^{-7}
Worker MEI	3.7×10^{-5}	1.2×10^{-4}
Population	1.3×10^{-4}	5.0×10^{-4}

same population each individual has a 1 in 13 risk of a fatal cancer over a 50 year lifetime from all other sources (Table 9) (). In other words, the additional cancer risk posed by the proposed project would not be discernable from the "normal" cancer fatality rate.

Calculated releases of non-radiological contaminants would be well below applicable health-based emissions limits (See Appendix A, page 58). For carcinogens, modelers calculated one-year average concentrations at the MEI location on the INEEL boundary. All concentrations would be below Idaho's Acceptable Ambient Concentrations for Carcinogens (AACCs) (see Appendix A).

4.2.8 Waste Management

Removal activities would generate about 1.6 M ft^3 of solid wastes, and 1.5 M gallons of liquid waste that would require handling, packaging, transport, storage, treatment, and/or disposal at other facilities such as the Radioactive Waste Management Complex (see Table 7). Approximately 25 percent of the solid waste volume is estimated as mixed waste or debris, 55 percent would be low-level radioactive waste, 17% would be high-level waste and the remainder would be industrial waste. Total removal of INTEC-601 and INTEC-603 complexes would generate about 150,000 gallons of liquid waste (see Table 7).

Extensive in-cell decontamination, remote techniques, shielding and personal protective equipment would be required to reduce personnel exposures during decontamination and removal. Even with these precautions, the estimated dose to workers removing the waste is 2.9×10^2 mrem. Additional unquantified exposures and accident risks would occur during waste transportation, treatment, and disposal. The dose as discussed in Section 4.1.7 would occur primarily during the first year of the proposed project.

LMICTO would remove and treat (as discussed in previous sections) most of the highly radioactive residue during the decontamination process. Relatively small quantities of fixed radioactive material would remain on the walls, floors, and equipment. During wet-decontamination activities, workers would generate liquid waste and direct it to the tank farm. These activities would make it more difficult to meet a commitment to the state of Idaho to empty the Tank Farm.

Removal activities may result in the release of contamination due to the large amount of work required to demolish the buildings. Removal activities such as decontamination and treatment may result in additional air emissions. Emissions from wet and dry decontamination and the calcining operations would account for the majority of the releases during this alternative. Additional emissions may occur during treatment of the waste streams removed from the facilities. DOE has not fully characterized the physical parameters, chemical composition, and radiological attributes of the waste materials and components. Thus, uncertainties exist regarding materials, specific waste treatment, disposal plans, and emissions from treatments.

4.3 Alternative 3: No Action

4.3.1 Continue "On-Going Operations" (3a)

The INTEC-601 Complex does not have a current mission, nor are any missions foreseen which would allow the buildings to be used. Modifying the facilities for another use is not practical for several reasons. The INTEC-601 and INTEC-640 facilities were designed and built for specific fuel reprocessing purposes and are highly radioactive. The cost to modify these facilities is likely prohibitive. The INTEC-627 laboratory facilities are obsolete and other newer facilities have replaced their function. In addition, DOE would have to upgrade the facilities to meet current building and environmental codes and standards.

Because most of these buildings are over 40 years old, surveillance and maintenance costs would likely increase over time. There is already a concern associated with leaking roofs and walls, equipment leaking, and materials such as asbestos insulation falling off into the building. Finally, it would eventually become necessary to deactivate the facilities. This would occur when DOE closes INTEC under CERCLA.

Therefore, the – Continue "on-going operations" – alternative would likely consist of the present surveillance and maintenance activities at the facilities. DOE currently spends about $3.5 million a year on surveillance and maintenance to maintain heat and operate the systems that are in the building. These costs would likely rise as it becomes more difficult to maintain these facilities as they become older. Some buildings are already nearing 50 years old. In addition, the cost of compliance would likely increase as potential contamination problems increase with the aging of the facilities.

Air emissions would continue as present, resulting in a calculated EDE of 1.94×10^{-2} mrem/year from the INTEC main stack emission (Keck and Abbott 1998). Modelers base this calculated dose on INTEC main stack emissions measured during 1997. The ventilation air from the INTEC-601 Complex contributes about 50 percent of the average main stack exhaust volume, but contributes less than 1 percent to the annual dose (Solle 1998). Approximately 99 percent of the dose from the main stack comes from I-129, there is no significant source of I-129 within the INTEC-601 Complex, therefore the INTEC-601 Complex cannot contribute to greater than 1 percent of the dose.

4.3.2 Discontinue "On-Going Operations" (3b)

It is likely that the discontinuation of "on-going operations" would violate environmental laws

Failure to continue surveillance and maintenance activities at the INTEC-601 or INTEC-603 Complexes would result in deterioration of buildings and potential release of radioactive and hazardous substances to the environment. Fugitive air emissions would likely occur as the buildings deteriorate. Deteriorating buildings could also allow the movement of animals, such as mice, in and out of the buildings, thus creating a potential biological pathway for radiation and toxic exposure. Storm water infiltration and drainage may occur as the roof and walls deteriorate resulting in potential soil and groundwater contamination. The INTEC-601 and INTEC-603 complexes may also be susceptible to floodwater intrusion from a maximum flood event coupled with MacKay Dam failure, as described in Section 3. Flooding of these facilities could release radiological and hazardous contamination to the surface water and groundwater, increasing potential exposure. In addition, the lack of maintenance of these structures would likely result in deterioration of structures that are eligible for nomination to the National Register of Historic Places. Since much less than 1 percent of the INTEC main stack dose comes from the INTEC-601 Complex, there would not be a change in the emissions from the INTEC main stack if the INTEC-601 Complex discontinued "On-Going Operations."

DOE may eventually deactivate these facilities when INTEC closes under CERCLA. However, the difficulties associated with the deactivation would increase with time. Escalation and the increasing deterioration of the facility would ultimately result in an increase in cost and increased risk of release of contaminated materials. In addition, it is likely that the discontinuation of "on-going operations" would violate environmental laws and regulations, such as RCRA, and endanger the health and safety of workers and the public.

4.4 Options

4.4.1 Option 1 – Atmospheric Protection System

Staley (1998) found no appreciable difference in dose to the maximally exposed individual between the different airflow options (Table 10). However, McManus (1998) calculated that as much as 150 gallons per hour could condense in the main stack if deactivation activities reduce the airflow by 63,000 scfm. This would increase the amount of wastewater directed to the PEW, and thus to the Tank Farm. Without heating the air or maintaining the exit velocity this amount would be closer to 585 gallons per hour.

Table 10. Dose estimates for Airflow Options -- Replace or Reduce Airflow.

Option	Stack Diameter (m)	Exit Temperature	Dose[a] (mrem)
Replace Airflow	2.0	Ambient	1.65×10^{-2}
Reduce Airflow	1.07	120°F.	1.60×10^{-2}

a. Dose to MEI at Frenchman's Cabin.

One of the major effects of losing 50,000 scfm of airflow is an increase in relative humidity within the main stack. Increased humidity and decreased airflow would render existing monitoring equipment inoperable and increase the amount of water condensing at the bottom of the main stack. In addition, reducing the airflow would cause inadequate dispersion of the airflow and increase the incidence of the plume dropping down inside the INTEC fence. Also, reducing the airflow would likely increase (double) the **opacity** of the orange plume, since the concentration of NO_x in the plume would double.

DOE would modify the operations and structure of the main stack to mitigate the above concerns. Mitigation could include the construction of a new **venturi** nozzle designed to maintain existing airflow velocity. Maintaining existing velocity would reduce condensation and worker exposure to the plume. In addition, DOE could purchase and install air heaters to increase stack gas temperatures from 70° F. to 120° F. to reduce condensation in the main stack. DOE could also replace the NOx, if NWCF is operating, and radionuclide monitors to monitor main stack gases. Plume opacity would still increase, if the NWCF were operating.

The potential shutdown of the NWCF,[14] INTEC-659, while not connected to this action, would affect both flow and air emissions. Solle (1998) found that the NWCF does not contribute the primary dose to the main stack. For instance, he found that during 1997, during a time the calciner was not running, about 83 percent (1.94×10^{-2} mrem) of the INEEL **effective dose equivalent** (EDE) for the entire year was released from the main stack.. Based on the 1996 and 1997 Radioactive Waste Management Information System data the dose (see Appendix A) from the main stack would not decrease appreciably if the calciner were shutdown. However, the majority of toxic chemicals emitted from the main stack do come from the calciner. Keck and Abbott (1988) assumed that the burning of kerosene in the calciner creates the majority of the toxic chemicals, but the risk from these chemicals is extremely small. The total cancer risk estimate for the inhalation route of exposure at the INEEL boundary is 8×10^{-7} for all receptors (Staley 1998), well below the EPA screening criterion of 1×10^{-5}. If the calciner were shutdown, the risk from these chemicals would only be less. In addition, the orange plume (the color of Nitrogen Oxides or NO_x) from the INTEC main stack comes solely from the calciner, therefore, if the calciner no longer operated the plume would no longer be present.

14 The State of Idaho has requested that the New Waste Calciner Facility, INTEC-659, shutdown on April 1999 if not permitted (DEQ 1998).

4.4.2 Option 2 – Resource Conservation and Recovery Act Closures

DOE is preparing a RCRA Closure Plan to demonstrate how closure will occur. The Idaho Division of Environmental Quality must approve the plan before initiation of closure activities. The plan will evaluate the potential impacts of closure activities. This EA discusses potential impacts to waste management in previous sections.

4.5 Cumulative Impacts

This section addresses potential cumulative impacts resulting from the proposed action and other past, present, or foreseeable actions. Evidence is increasing that the most devastating environmental effects may result not from the direct effects of a particular action, but from the combination of individually minor effects of multiple actions over time (CEQ 1997).

. . .cumulative impacts resulting from the proposed action and other past, present, or foreseeable actions.

CEQ's guidelines provide a framework for addressing environmental impact. The methodology used to evaluate potential cumulative effects for this EA are in Appendix C, "Cumulative Impact Methodology."

This Section describes the overall potential for cumulative effects based on an analysis compiled in the FEIS cited earlier in this EA. In addition, the Section evaluates the potential cumulative effects to each of the major disciplines (e.g., air, water, geology, biology) resulting from carrying out Alternative 1a. Where possible, this EA provides a "quantitative" approach to cumulative affects, but depending on availability of information also uses a "qualitative" approach.

D&D Projects Identified and Analyzed in the FEIS

- ***Central Liquid Waste Processing Facility, ANL***
- ***Engineering Test Reactor, TRA***
- ***Materials Test Reactor, TRA***
- ***Fuel Processing Complex, INTEC***
- ***Fuel Receiving and Storage Facility, INTEC***
- ***Headend Processing Plant, INTEC***
- ***Waste Calcine Facility, INTEC (in progress)***

The buildings associated with the INTEC-601 Complex are three of seven decontamination and decommissioning projects identified and analyzed in the FEIS (FEIS, Volume 2, Sections C-4.2.1 through C-4.2.7). Based on the analyses done in the FEIS, "no reasonably foreseeable cumulative adverse impacts are expected to the surrounding populations . . ." (see FEIS, Section 5.20.3.5.3 — *Cumulative Impacts*, p. 5.20-13). In addition, future CERCLA documents, such as cumulative Remedial Investigations and Feasibility Studies would address the cumulative impacts of restoration efforts at the INTEC or Waste Area Group 3, as well as other Waste Area Groups. The closure of the INTEC-601 Complex and INTEC-603 Complex would consume irretrievable amounts of electrical energy, fuel, and miscellaneous chemical, concrete, metals, plastics, lumber, sand, gravel, silt and clay, and water. DOE intends that the proposed deactivation is the final remedy for these facilities. However, deactivation by grouting in-place is not "an irreversible" decision. While such a decision is improbable, workers could size, remove, and dispose of the concrete-filled facilities at some future date.

4.5.1 Air Resources

Table 11 shows the radiological releases from current and future INEEL operations (DOE 1995a) to the worker, maximally exposed individual, and the population within 50 miles of the INEEL. The incremental and cumulative average annual dose includes emissions associated with the deactivation of the INTEC-601 Complex. The risk to an INEEL worker from airborne radionuclide emissions would cause an estimated increased lifetime chance of developing fatal cancer of less than 1 in 22,700 (Table 11). Modelers conservatively summed radiological dose impacts to the maximally exposed individual to derive cumulative impacts, although the location of the maximally exposed individual may be different for each source. This conservatism serves to establish the upper-bounding dose. Despite this conservatism, the dose to the maximally exposed individual is low (Table 11) and would result in a fatal cancer risk for the maximally exposed individual of less than 1 occurrence in 3,300,000. A one-year cumulative dose from existing and planned INEEL operations would produce about 0.003 additional fatal cancers in the entire surrounding population. For perspective, about 37.9 cancer deaths occur from all other sources each year according to the NCI (1994). Radiological releases resulting from the proposed action, present INEEL operations, and other proposed future actions would not be expected to cause measurable adverse health effects to workers, the maximally exposed individual, or the public.

Cumulative effects from deactivation activities associated with air emissions are shown in Table 11 for the recently started project, Closure of the Waste Calcine Facility and the proposed Deactivation of the INTEC-601 Complex and the INTEC-603 Complex. The air emissions are fugitive releases of radionuclides and other hazardous substances or contaminants of concern during the deactivation and grouting process. The cumulative worker dose calculated for the projects described above is 110 mrem/year. This dose is would likely be far less because of conservative assumptions used in the analyses (see Section 4.2.1).

4.5.2 Geology and Soil Resources

Individually, the monoliths created by deactivating and grouting the INTEC-601 Complex and INTEC-603 Complex in-place do not have a significant impact on the groundwater quality. Modelers have shown that dose concentrations and cancer risks are low (see 4.1.7). However, the continued practice of deactivating facilities by grouting in-place would leave several concrete monoliths that could become subject to geologic events such as stream meanders, volcanic eruptions, and earthquakes. Section 0 states that volcanic or seismic events are probably incapable of cracking or damaging the subsurface concrete monoliths resulting from the deactivation-in-place alternative. Probabilities of inundation of the area by basalt lava flows are in the range of 10^{-6} per year and volcanism does not pose a threat to the deactivation-in-place alternative. Therefore, unless significant changes occur in climatic (e.g., a wetter, colder) that would increase the precipitation and water flow, cumulative impacts are not expected to occur to the geology (or soil) of the INEEL.

4.5.3 Water Resources

DOE does not expect impacts to surface water flows from these or other similar deactivation projects. In addition, it is unlikely that any damage to the concrete-encased buildings or leakage of radionuclide or hazardous chemicals would occur as a result of floods (see Section 4.1.3). Rainwater is a common vehicle to convey contaminants to the groundwater. Effective Storm Water Pollution Prevention measures should take care of potential cumulative impacts to surface water and the potential for the deactivated facilities to contaminate groundwater.

Table 11. Radiological Air Emission Baseline and Cumulative Dose[a] and Cancer Risk from Deactivation In-Place and Deactivation By-Removal Alternative for INTEC-601 Complex and INTEC-603 Complex.

		Deactivation (Leave In-Place)			
	INEEL Baseline[b]	WCF[c]	INTEC-601 Complex[d]	INTEC-603 Complex[d]	Cumulative from Existing and Proposed INEEL Activities[e]
			Alternative 1a		
			Dose		
Nearby Worker	3.2×10^{0}	1.4×10^{-7}	1.5×10^{1}	9.4×10^{1}	1.19×10^{2}
Off-Site MEI	5.0×10^{-1}	1.5×10^{-9}	1.2×10^{-2}	8.7×10^{-2}	9.90×10^{-2}
Population within 50 miles[g]	3.0×10^{0}	2.5×10^{-8}	4.3×10^{-2}	3.2×10^{-1}	3.63×10^{-1}
			Cancer Risk		
Nearby Worker	1.3×10^{-6}	5.6×10^{-14}	6.2×10^{-6}	3.8×10^{-5}	4.42×10^{-5}
Off-Site MEI	2.5×10^{-7}	7.5×10^{-16}	6.0×10^{-9}	4.3×10^{-8}	$4.90.0 \times 10^{-8}$
Population within 50 miles	1.5×10^{-3}	1.3×10^{-11}	2.2×10^{-5}	1.6×10^{-4}	1.82×10^{-4}
			Alternative 1b		
			Dose		
Nearby Worker	3.2×10^{0}	1.4×10^{-7}	1.1×10^{2}	9.4×10^{1}	2.04×10^{2}
Off-Site MEI	5.0×10^{-1}	1.5×10^{-9}	8.4×10^{-2}	8.7×10^{-2}	1.71×10^{-1}
Population within 50 miles	3.0×10^{0}	2.5×10^{-8}	3.1×10^{-1}	3.2×10^{-1}	6.30×10^{-1}
			Cancer Risk		
Nearby Worker	1.3×10^{-6}	5.6×10^{-14}	4.4×10^{-5}	3.8×10^{-5}	8.20×10^{-5}
Off-Site MEI	2.5×10^{-7}	7.5×10^{-16}	4.2×10^{-8}	4.3×10^{-8}	8.5×10^{-8}
Population within 50 miles	1.5×10^{-3}	1.3×10^{-11}	3.1×10^{-1}	3.2×10^{-1}	6.3×10^{-1}
			Alternative 1c		
			Dose		
Nearby Worker	3.2×10^{0}	1.4×10^{-7}	1.1×10^{1}	9.4×10^{1}	1.05×10^{2}
Off-Site MEI	5.0×10^{-1}	1.5×10^{-9}	8.2×10^{-3}	8.7×10^{-2}	9.52×10^{-2}
Population within 50 miles	3.0×10^{0}	2.5×10^{-8}	3.0×10^{-2}	3.2×10^{-1}	3.50×10^{-1}
			Cancer Risk		
Nearby Worker	1.3×10^{-6}	5.6×10^{-14}	4.2×10^{-6}	3.8×10^{-5}	4.22×10^{-5}
Off-Site MEI	2.5×10^{-7}	7.5×10^{-16}	4.1×10^{-9}	4.3×10^{-8}	4.71×10^{-8}
Population within 50 miles	1.5×10^{-3}	1.3×10^{-11}	1.5×10^{-5}	1.6×10^{-4}	1.75×10^{-4}

	Deactivation (Removal)			
	WCF[c]	INTEC-601 Complex[f]	INTEC-603 Complex[f]	Cumulative from Existing and Proposed INEEL Activities[e]
		Alternative 2		
		Dose		
Nearby Worker	8.1×10^{-7}	9.2×10^{1}	2.9×10^{2}	3.9×10^{2}
Off-Site MEI	8.5×10^{-9}	7.1×10^{-2}	2.7×10^{-1}	8.4×10^{-1}
Population within 50 miles[g]	1.4×10^{-7}	2.6×10^{-1}	9.9×10^{-1}	4.3×10^{0}
		Cancer Risk		
Nearby Worker	3.2×10^{-13}	3.7×10^{-5}	1.2×10^{-4}	1.6×10^{-4}
Off-Site MEI	4.3×10^{-15}	3.6×10^{-8}	1.3×10^{-7}	4.2×10^{-7}
Population within 50 miles	7.0×10^{-11}	1.3×10^{-4}	5.0×10^{-4}	2.1×10^{-3}

Background Dose is 3.5×10^{2}. Background refers to the naturally occurring radiation, see HELPFUL INFORMATION FOR THE READER, p. i.

a. Reported in mrem, except for Population, which is reported in person-rem.
b. FEIS, Volume 2, Table 5.12-1, p. 5.12-7 (DOE 1995a)
c. DOE/EA-1149, Table 2, p. 24, (DOE 1996b).
d. See Section 4.1.1.
e. FEIS, volume 2, Table 5.12-2, p. 5.12-8 (DOE 1995a) and converted to an annual dose. Based on implementation of projects in the FEIS, including the WCF Closure and INTEC-601 Complex, but not the INTEC-603 Complex.
f. See Section 2.2.
g. Cumulative radiation dose (person-rem) to the populations within 50 miles of site facilities from INEEL operations from 1995 to 2005.

4.5.4 Biological Resources

DOE does not expect cumulative impacts to the biological resources of the INEEL from deactivation of the facilities described earlier in this EA. However, grouting in-place would eliminate the possibility for modest habitat improvement in the future. That is, total removal and subsequent revegetation would result in small increases in wildlife habitat. If DOE were to remove and rehabilitate all of INTEC, local increases in some wildlife populations would be likely. Grouting-in-place precludes any contribution to potential cumulative habitat improvement. For instance, removing instead of grouting buildings in-place at the INTEC would likely result in an unmeasurable increase in habitat and wildlife (herpitiles, passerine birds, small mammals) over the INEEL. However, if DOE removed all of INTEC and rehabilitated the habitat, effects are likely to be measurable on a small scale.

4.5.5 Cultural Resources

All undertakings on the INEEL have the potential to impact properties that are eligible for nomination to the National Register of Historic Places. In many instances, particularly in the case of archaeological resources, these impacts are avoidable through slight changes in project plans. When historic structures are involved, it is more difficult to avoid direct impacts. Impacts are adverse if the undertaking destroys structures or portions of these structures that make them eligible for nomination (see Sections 4.1.5). The undertakings from the proposed action, resulting in adverse impacts to historic INEEL properties and/or archaeological sites would proceed only in accordance with all of the substantive requirements resulting from consultation between the DOE-ID, the Idaho State Historic Preservation Office (SHPO) and other interested parties (see Section 2.5). DOE does not expect cumulative impacts to the cultural resources of the INEEL from these projects.

4.5.6 Land Use and Visual Resources

Current development uses only about 2 percent of area consisting of the INEEL. Even if all the facilities on the INEEL were deactivated and grouted in-place the cumulative impact to land resources would be small – about 11,000 acres of a total 569,295 acres.

4.5.7 Health Effects

Table 12 shows the risks from the same eight radionuclides at these facilities compared to the results from the WCF risk assessment (see Rood 1996 et al.) and the High Level Waste no action risk assessment for the Tank Farm (Stepan and McCarthy 1997)

4.6 Environmental Justice

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, states that Federal Programs and actions shall not disproportionately affect minority or low-income populations. None of the alternatives addressed in this EA would adversely affect any particular cultural or socioeconomic group of people more than the general population as a whole. Hence, without significant impacts, there are no disproportionately high and adverse impacts.

The region(s) of influence (ROI) (see Appendix, page 77) surrounding the INEEL, with respect to the alternatives discussed herein, are different for the various environmental media that might be effected. The following discusses each of these ROIs. The ROIs for resources (disciplines) are limited to the within the fence of the INTEC Facility or at the most the INEEL boundary. A few resources, such as air, land and health while having larger ROIs, have small impacts that would not be seen beyond the INTEC facility or the INEEL boundaries.

Table 12. Cancer risks for radionuclides in the residential groundwater ingestion pathway for INTEC-Complex, INTEC-603 Complex, Waste Calcine Facility, and the High Level Waste Tank Farm.[a]

Radionuclides	INTEC-601 Complex	INTEC-603 Complex	WCF[b]	Tank Farm[c]
Ac-227				$1x10^{-9}$
Am-241				$1x10^{-9}$
I-129	$4x10^{-7}$			$7x10^{-3}$
Nb-94		$2x10^{-6}$		
Np-237			$1x10^{-8}$	$4x10^{-4}$
Pa-231				$1x10^{-8}$
Pb-210				$3x10^{-5}$
Pu-239		$4x10^{-5}$	$5x10^{-9}$	
Pu-240			4x10-10	
Ra-226				$5x10^{-6}$
Sm-151	$2x10^{-6}$			
Sr-90	$3x10^{-7}$	$8x10^{-7}$		
Tc-99			$2x10^{-6}$	$4x10^{-5}$
Th-229				$2x10^{-8}$
Th-230				$5x10^{-6}$
Th-232				$2x10^{-15}$
U-233				$2x10^{-6}$
U-234		$1x10^{-6}$		$6x10^{-3}$
U-235		$5x10^{-7}$		$8x10^{-8}$
U-236				$2x10^{-6}$
U-238				$4x10^{-4}$
Total	$3x10^{-6}$	$4x10^{-5}$	$2x10^{-6}$	$1x10^{-2}$

a. With the exception of the WCF, the contamination source for the GWSCREEN runs was assumed to be at what is currently the south fence of the INTEC. The contamination source for the WCF is assumed to be directly below the facility. The residential scenarios were assumed to be at 100 years for each of the facilities except the Tank Farm. It was assumed that the tanks would not breach at the Tank Farm for 500 years, so this risk assessment is based on a 500 year residential scenario.

b. See Rood et al. 1996.

c. See Stepan and McCarthy 1997.

4.7 Comparison of Environmental Impacts

DOE would undertake several mitigative measures to reduce the impact to the environment, workers, and the public. Table 2 summarizes these measures. This EA describes the impacts of each alternative in Sections 4.1, 0, and 4.3. Table 13, Table 14, andTable 15 summarize deactivation and post-deactivation and project costs and duration. This EA found that the biggest differences between alternatives are in worker dose, waste disposal, and project duration and cost.

The alternative with the largest cancer risk from airborne contaminants during deactivation activities to the MEI and population is Alternative 2. Alternative 1b and 1d would result in the greatest exposure to the MEI and population through ingestion during post-deactivation activities. External doses to workers would be greatest with alternative 1b. Alternative 1a, 1b, or 1c would generate less waste material then Alternative 2. However, Alternatives 1a, 1b, and 1c require a 30-year surveillance and maintenance of closed RCRA Units.

The No Action alternative poses greater risks to all receptors over the long-term. For instance, the radionuclide emissions to the air would continue and health risks associated with exposure and groundwater ingestion would be higher for the No Action alternative than for any of the other alternatives.

Alternative 2 would cost about 16 times as much as the proposed alternatives (1a and 1d). Alternatives 1c and 3 ("Continued" No Action) would result in increasing surveillance and maintenance costs.

Table 13. Summary of Deactivation Impacts Across Alternatives.

	Alternative 1 (Leave In-Place)				Alternative 2 (Removal)		Alternative 3[a]	
	INTEC-601			INTEC-603	INTEC-601	INTEC-603	"Continue"	"Discontinue"
Deactivation Impacts	1a	1b	1c	1d	2	2	3a	3a
Air Emissions								
MEI Dose	$1.2x10^{-2}$	$8.4x10^{-2}$	$8.2x10^{-3}$	$8.7x10^{-2}$	$7.1x10^{-2}$	$2.7x10^{-1}$		
Worker Dose	$1.5x10^{1}$	$1.1x10^{2}$	$1.1x10^{1}$	$9.4x10^{1}$	$9.2x10^{1}$	$2.9x10^{2}$		
Population Dose	$4.3x10^{-2}$	$3.1x10^{-1}$	$3.0x10^{-2}$	$3.2x10^{-1}$	$2.6x10^{-1}$	$9.9x10^{-1}$	N/A	N/A
Soil	Minor & localized impacts	Minor & localized impacts	Minor & localized impacts	Minor & localized impacts	Minor & localized impacts	Minor & localized impacts	N/A	N/A
Geology								
Seismic	None	None	None	None	None	None		
Subsidence	<1 inch	<1 inch	<1 inch	<1 inch	None	None	N/A	N/A
Surface Water	None	None	None	None	None	None	N/A	N/A
Groundwater	None	None	None	None	None	None	N/A	N/A
Biological Resources	None	None	None	None	None	None	N/A	N/A
Cultural Resources								
(Historical)	Destroy structures eligible for National Register	Destroy structures eligible for National Register	Destroy structures eligible for National Register	Destroy structures eligible for National Register	Destroy structures eligible for National Register	Destroy structures eligible for National Register	N/A	N/A
(Archeological)	None	None	None	None	None	None	N/A	N/A
Land Use	None	None	None	None	None	None	N/A	N/A
Visual	Short-term construction related impacts	Short-term construction related impacts	Short-term construction related impacts	Short-term construction related impacts	Short-term construction related impacts	Short-term construction related impacts	N/A	N/A
Health Effects								
Airborne (mrem)								
MEI Cancer Risk	$6.0x10^{-9}$	$4.2x10^{-8}$	$4.1x10^{-9}$	$4.3x10^{-8}$	$3.6x10^{-8}$	$1.3x10^{-7}$		
Worker Cancer Risk	$6.2x10^{-6}$	$4.4x10^{-5}$	$4.2x10^{-6}$	$3.8x10^{-5}$	$3.7x10^{-5}$	$1.2x10^{-4}$		
Population Cancer Risk	$2.2x10^{-5}$	$1.5x10^{-4}$	$1.5x10^{-5}$	$1.6x10^{-4}$	$1.3x10^{-4}$	$5.0x10^{-4}$		
Groundwater (mrem)	None	None	None	None	None	None	N/A	N/A
External Exposure								
Man-rem	1.5-2.0	100-150	1.5-2.0	20	750	>50		
Waste Management See Table 7	Few cubic feet of waste material	Decrease waste left in-place, Increase waste to disposal site	Few cubic feet of waste material	Few cubic feet of waste material	1.6 M cubic feet of waste and 1.5 M gallons of liquid waste		N/A	N/A

a. N/A -- Not applicable because no action does not include a Closure Activity.

Table 14. Summary of Post-Deactivation Impacts Across Alternatives.

Deactivation Impacts	Alternative 1 (Leave In-Place) INTEC-601 1a	Alternative 1 (Leave In-Place) INTEC-601 1b	Alternative 1 (Leave In-Place) INTEC-601 1c	Alternative 1 (Leave In-Place) INTEC-603 1d	Alternative 2 (Removal)[a] INTEC-601 2	Alternative 2 (Removal)[a] INTEC-603 2	Alternative 3 "Continue" 3a	Alternative 3 "Discontinue" 3a
Air Emissions	No Post-Deactivation Impacts	No Post-Deactivation Impacts	No Post-Deactivation Impacts	No Post-Deactivation Impacts	No Post-Deactivation Impacts	No Post-Deactivation Impacts	1.94×10^{-2} mrem/year from INTEC main stack	Lack of Surveillance and Maintenance would result in potential environmental releases and contamination. While structures would remain intact, lack of S&M would result in deterioration of facility structures. It is likely that this alternative would violate environmental laws and regulations.
Soil	None	None	None	None	None	None	None	
Geology								
Seismic	About 10^{-6}	About 10^{-6}	About 10^{-6}	About 10^{-6}	None	None	About 10^{-6}	
Subsidence	None	None	None	None	None	None	None	
Surface Water								
Flooding Risk	10^{-6} to 10^{-8}	10^{-6} to 10^{-8}	10^{-6} to 10^{-8}	10^{-6} to 10^{-8}	None	None	10^{-6} to 10^{-8}	
Groundwater	see Health Effects	see Health Effects	see Health Effects	see Health Effects	None	None	None	
Biological Resources	Lost of 1 ac. Natural Productivity	Lost of 1 ac. Natural Productivity	Lost of 1 ac. Natural Productivity, potential access by small animals	Lost of 0.6 ac. Natural Productivity	Potential return of 1 ac. to Natural Productivity	Potential return of 0.6 ac. to Natural Productivity	None	
Cultural Resources (Historical & Archeological)	None Expected	None Expected	None Expected	None Expected	None Expected	None Expected	None	
Land Use	Long-term Restriction on Use <2% of INEEL Area	Long-term Restriction on Use <2% of INEEL Area	Long-term Restriction on Use <2% of INEEL Area	Long-term Restriction on Use <2% of INEEL Area	May be long-term positive benefits with return of land	May be long-term positive benefits with return of land	None	
Visual Resources	20-25 foot Monoliths Left In-Place	20-25 foot Monoliths Left In-Place	20-25 foot Monoliths Left In-Place	20-25 foot Monoliths Left In-Place	None	None	None	
Health Effects	None	None	None	None	None		Continued existing dose	
Airborne	None	None	None	None	None			
Groundwater (mrem)	3.5×10^{-6}	3.5×10^{-6}	None	4×10^{-5}	None			
External Exposure	None	None	None	None	None			
Waste Management	30-year S&M	30-year S&M	30-year S&M	30-year S&M	Waste management and/or monitoring at other disposal locations.			

a. Impacts unknown because since wastes stored at other location (e.g., RWMC, Off-Site Storage Site).

Table 15. Summary of Estimated Costs (Deactivation & Surveillance and Maintenance) and Duration Across Alternatives.

Deactivation Impacts	Alternative 1 (Leave In-Place) INTEC-601 1a	1b	1c	INTEC-603 1d	Alternative 2 (Removal) INTEC-601 2	INTEC-603 2	Alternative 3 "Continue" 3a	"Discontinue" 3a
Costs (in millions)								
Deactivation & Post Deactivation	$30-40	$394	$16	$19	$666	$200	None	None
Surveillance & Maintenance	None	None	$2 M annually	None	None	None	$3-4 M annually	None

a. Surveillance and maintenance costs will likely increase over time.

5 PERMIT AND REGULATORY REQUIREMENTS

5.1 Federal Government and Tribes

Section 106 of the National Historic Preservation Act of 1966, as amended, requires agencies to consider the impact of undertakings on properties listed or eligible for listing in the National Register of Historic Places and to consult with the SHPO and other interested parties when impacts are likely. Section 110 directs federal agencies to establish programs to find, evaluate and nominate eligible properties to the National Register of Historic Places, including previously unidentified historic properties that may be discovered during the implementation of a project (36 CFR Part 800). In addition, the Archaeological Resource Protection Act of 1979, as amended, provides for the protection and management of archaeological resources on federal lands.

Subpart M of EPA's regulations for NESHAP (40 CFR 61.145 through 61.155) contains standards for demolishing buildings containing friable asbestos and for asbestos waste disposal. The regulations require specific notifications and reporting to the EPA. The regulatory standards specify procedures to control visible emissions and reduce safety risks during typical asbestos stripping, removal, and landfill disposal activities. The deactivation activities would encase asbestos materials in grout for disposal-in-place. The grouting process and emission controls would prevent visible asbestos emissions. However, the disposal-in-place action would create a site subject to portions of 40 CFR 61.151 and 154 such as warning signs, record keeping, and notation on land title.

Before soil-disturbing activities related to closure of INTEC-601, -603, -627, and -640 begin, a project Storm Water Pollution Prevention Plan (SWPPP) needs to be prepared and approved in accordance with the current INEEL Construction Activities SWPPP. Erosion prevention and sediment controls would be implemented according to best management practices from EPA's Storm Water Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices (EPA 1992). DOE would manage the facilities, during post-closure phases, in accordance with the current INEEL Industrial Activities SWPPP.

The Endangered Species Act requires agencies to consider potential impacts to Threatened and Endangered species, and their habitats, and enter a Section 7 Biological Consultation with the U. S. Fish and Wildlife Service if necessary. Compliance with other natural resource regulations, such as the Migratory Bird Treaty Act, the Noxious Weed Act, and various wetland conservation statutes, is required.

DOE-ID consults with the Shoshone-Bannock Tribes in a government-to-government relationship formalized in a "Working Agreement/Agreement in Principle" (DOE 1992). The Tribes are keenly interested in many INEEL activities and monitor many to ensure that the plant, animal, water, air and land resources important to them are adequately protected.

5.2 State and Local

The Idaho Division of Environmental Quality Air permitted the emissions from the INTEC main stack under the INTEC Nitrogen Oxide Sources Permit to Construct (PTC 023-0001) issued on February 13, 1995. The permitted limit for radionuclide emissions is 10 mrem/yr., in aggregate with all other INEEL sources. The airflow option described in Section 2.4.1 would require minor modification to the air permit-to-construct (PTC).

The RCRA closure performance standards of IDAPA § 16.01.05.009, *"Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities"* require the design and construction of a low-permeability cover over the unit to reduce the migration of liquids into the grouted structure. The owner or operator of a hazardous waste management facility must close the facility in a manner that:

- Minimizes the need for further maintenance
- Controls, reduces, or eliminates, to the extent necessary to protect human health and the environment, post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated run-off, or hazardous waste decomposition products to the ground or surface waters or to the atmosphere
- Complies with the closure requirements of this subpart IDAPA 16.01.05.009 [40 CFR 265].

These state regulations, in addition to prescribing other requirements, incorporate by reference the federal regulations, found in 40 CFR Part 265, defining the requirements for facilities granted interim status pursuant to the RCRA.

DOE is preparing a RCRA Closure Plan to demonstrate how the selected alternative would comply with RCRA requirements. The Idaho Division of Environmental Quality must approve the Closure Plan before initiation of closure activities.

6 COORDINATION AND CONSULTATION

DOE is required to review as guidance the most current U. S. Fish and Wildlife Service (FWS) list for threatened and endangered (T&E) plant and animal species. If, after reviewing the list, DOE determines that the proposed action would not impact any T&E species, DOE may determine or document that formal consultation with the FWS is not required for this action. The Environmental Science and Research Foundation performs independent T&E species reviews for DOE. They have advised DOE that a biological assessment would not be required for the proposed action or alternative actions (see Section 4.1.4, page 27) (Reynolds 1998).

DOE must consult with the SHPO as required by Section 106 of the National Historic Preservation Act before commencement of any activities associated with the proposed action or alternative actions (Section 4.1.5). DOE-ID regularly consults with the Shoshone-Bannock Tribes under the "Working Agreement / Agreement in Principle". For draft EAs concerning proposed actions that may affect the Tribes, DOE-ID offers a 14 to 30 day comment period.

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GLOSSARY

A

Alluvial or **Alluvium.** Sediment deposited by flowing water, as in a riverbed, flood plain, or delta., 21

Alternatives. The range of reasonalbe options, including the No Action alternative, considered in selecting an approach to meeting the proposed objectives., 2

Aquifer. A body of rock or sediment sufficiently permeable to conduct groundwater and to yield significant quantities of water to wells and springs. The Snake River Aquifer underlies the INEL., 21

B

Basalt. A hard, dense, dark volcanic rock composed chiefly of plagioclase, pyroxene, and olivine, and often having a glassy appearance., 21

C

Calcine. The materials produced by calcination. Calcination is the process of converting high-level waste to unconsolidated granules or powder (also called calcining)., 17

Caliche. A layer of hard subsoil or clay. Also called caliche., 21

Comprehensive Environmental Response, Compensation, and Liability Act., 3

D

Deactivate. Deactivation applies to facilities anticipated to require additional efforts due to the presence of radiological contamination. Deactivation involves a process of placing a facility in a safe and stable condition to minimize the long-term cost of a surveillance and maintenance. The process involves the removal of chemicals, draining and/or de-energizing of non-essential systems, removal of stored hazardous substances and related actions. The actions, based on facility-specific considerations and final disposition plans, can accomplish operations-like final process runs and decontamination leading to turnover to the Decontamination and Dismantlement Department (D&D).Such actions bridge deactivation and the turnover to D&D., 1

Decommissioning. The process of removing a facility from operation (deactivation), followed by decontamination, entombment, dismantlement, or conversion to another use., 2

Decontaminating. The actions taken to reduce or remove substances that pose a substantial present or potential hazard to human health or the environment, such as radioactive contamination from facilities, soil, or equipment by washing, chemical action, mechanical cleaning, or other techniques., 14

Dismantling. Dismantling involves the disassembling or demoliting and removing a structure, system, or component and the satisfactory interim or long-term disposal of the residue from all or portions of a facility., 14

Dissolution. Reduction to a liquid form or liquefaction., 3

E

Environmental Assessment (EA). A concise public document for which a Federal agency is responsible that serves to (1) Briefly provide sufficient evidence and analysis for determining whether to prepare an environmental impact statement or a finding of no significant impact., 2

Environmental Impact Statement (EIS). A detailed environmental analysis ofor a proposed major Federal action that could significantly affect the qualityof the human environment. A tool to assist in decisionmaking, it describes the positive and negative environmental effects of the proposed undertaking and alternatives., 2

Eolian. Relating to, caused by, or carried by the wind., 21

F

Finding of No Significant Impact. A document, based on an environmental assessment by a federal agency briefly presenting the reasons why an action will not have a significant effect on the human environment and for which an environmental impact statement will therefore not be prepared., 2

Floodplain. A plain bordering a river and subject to flooding., 21

G

Grouting in-place. The basic concept of grouting a facility in-place is to isolate or reroute the building utilities, remove or demolish all equipment and piping, demolish the building roof and walls, demolish the structural steel framing, and place the majority of these materials in or on top of the facility and then fill the voids such as vaults, rooms, stairways, cells with concrete. A reinforced concrete cover is then placed over the facility., 9
GWSCREEN., 67

H

High Blow Counts. Blow counts are the number of blows of a 140-pound hammer falling 4 feet required to drive a split spoon sampler one foot into a soil or sediment. Obviously the higher the blow count the more unyielding the sediment or soil., 26
Holocene. Of, belonging to, or designating the geologic time, rock series, or sedimentary deposits of the more recent of the two epochs of the Quaternary Period, extending from the end of the Pleistocene Epoch to the present., 22

I

Idaho Hazardous Waste Management Act (HWMA). Idaho Hazardous Waste Management Act, IDAPA 16.01.05, *Rules and Standards for Hazardous Waste* are the rules adopted pursuant to the authority vested in the Board of Health and Welfare by the Hazardous Waste Management Act of 1983, Sections 39-4401 et seq., Idaho Code. Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities, IDAPA 16.01.005.009, incorporate by reference 40 Code of Federal Regulations (CFR) Part 265, and all Subparts (excluding Subpart R and 40 CFR Parts 265.149 and 265.150) revised as of July 1,1994. (4-26-95)., 1
Injection Wells. Wells into which fluids are injected for purposes such as waste disposal., 22
interim status. RCRA interim status facility Hazardous waste management facilities (that is, treatment, storage, or disposal facilities) subject to Resource Conservation and Recovery Act requirements that were in existence on the effective date of regulations are considered to have been issued a permit on an interim basis as long as they have met notification and permit application submission requirements. Such facilities are required to meet interim status standards until they have been issued a final permit or until their interim status is withdrawn., 13
Internal Scoping Procedures., 2

L

Landfill standards. DOE would follow requirements outlined in 40 CFR 265.310. Regulations require owners to provide long-term control of liquids, function with minimum maintenance, promote drainage and minimize erosion of cover, accommodate settling, and others., 16
Leachate. A product or solution formed by leaching, especially a solution containing contaminants picked up through the leaching of soil., 17
Liquefaction. The process of liquefying., 26

M

Maximum exposed individual. A hypothetical individual defined to allow dose or dosage comparison with numerical criteria for the public. This individual is located at the point on the DOE site boundary nearest to the facility in question., 24
Microshield., 67
Mitigative Measures. Those actions that avoid impacts altogether, minimize impacts, rectify impacts reduce or eliminate impacts, or compensate for the impact. In this case they are actions that are incorporated into the project design to minimize or eliminate potential impacts., 19

N

National Environmental Policy Act (NEPA). A Federal law, enacted in 1970, that requires the Federal government to consider the environmental impacts of, and alternatives to, major proposed actions in its decisionmaking processes. Commonly referred to by its acronym, NEPA., 2
Nonfriable, 10

O

Opacity. In this case, opacity refers to the visibility of the plume – the greater the opacity, the more visible or opaque the plume., 36

P

Percolation. The movement of water downward and radially through the sub-surface soil layers, usually continuing downward to the groundwater., 22

Perennial. A plant that lives three or more years., 21

Performance standard base. DOE would follow requirements outlined in 40 CFR 265.111. Regulations require owners to minimize the need for further maintenance, control or minimize or eliminate post-closure escape of hazardous waste and constiutents, leachate, contaminated run-off, or hazardous waste decomposition products., 12

Permeable. That can be permeated or penetrated, especially by liquids or gases, such as rock that is permeable by water., 21

Pleistocene. Of, belonging to, or designating the geologic time, rock series, and sedimentary deposits of the earlier of the two epochs of the Quaternary Period, characterized by the alternate appearance and recession of northern glaciation and the appearance of the progenitors of human beings., 21

Precast. Relating to or being a structural member, especially of concrete, that has been cast into form before being transported to its site of installation., 10

Prevention of Significant Deterioration (PSD) Clean Air Act regulations designed to '*protect public health and welfare from any actual or potential adverse effect* . . .', U. S. Code, Title 42, The Public Health and Welfare, Chapter 85--Air Pollution Prevention and Control, Subchapter I--Programs and Activities, Part C--Prevention of Significant Deterioration of Air Quality., 20

Probable Maximum Flood. Hypothetical flood that is considered to be the most severe event possible., 20

R

Radioactive Exposure. Radiation exposure is expressed as Roentgen (R), the amount of ionization produced by gamma radiation in air. Dose is given in units of *Roentgen equivalent man* or rem, which takes into account the effect of radiation on tissues (see *Helpful Information for the Reader, p. ii)*, 1

Radiopharmaceuticals., iii

Record of Decision. A public document that records the final decision(s) concerning a proposed action. The Record of Decision is based in whole or in part on information and technical analysis generated either during the Comprehensive Environmental Response, Compensation, and Liability Act) process or the National Environmental Policy Act (NEPA) process, both of which take into consideration public comments and community concerns., 2

Resource Conservation and Recovery Act (RCRA). A regulatory statute designed to provide 'cradle-to-grave' control of hazardous waste by imposing management requirements on generators and transporters of hazardous wastes and upon owners and operators of treatment, storage, and disposal facilities., 1

RESRAD., 67

Rinsate. The liquid waste resulting from decontamination activities., 18

S

Seismic. Of, subject to, or caused by an earthquake or earth vibration., 26

Shear Wave Velocity. Shear wave velocity equals the velocity at which shear waves travel through a rock or sediment or soil. The higher the velocity, the more elastic and strong the material is., 26

Size. The result of compaction, melting, or mechanical reduction of wastes thereby minimizing the empty spaces or space requirements, 10

Sole-source Aquifer. A designation granted by the EPA when groundwater from a specific aquifer supplies more than 50 percent of the drinking water for the area overlying the aquifer. Federal financial assistance to projects which are determined to be potential unhealthy for the aquifer may be limited or withheld., 21

Spent Nuclear Fuel. Fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated. For the purposes of this EIS, spent nuclear fuel also includes uranium/neptunium target materials, blanket subassemblies, pieces of fuel, and debris., 2

Subsidence. Subsidence is a general geologic term for usually slow, sinking of the surface of the land. Subsidence occurs in a number of ways -- sinking of heavy structures into soft soil, groundwater withdrawal, collapse of underground cavities, or some tectonic process causing the crust of the earth to warp or bend downward. In geotechnical terminology, subsidence is usually not used. Instead, one of two terms are used - settlement or consolidation. Settlement always happens when building a heavy structure ion anything, including solid rock. It is instantaneous and depends on the elastic properties of the foundation material. This happens when you fill structures with concrete, but only to the tune of an inch or less. Consolidation however is a serious concern because it is a long-term process, it can involve several inches to feet of downward movement, and it can occur differentially causing cracking of the structure. Geologists do not expect this to occur when filling ICPP structures with grout., 26

Surficial. Of, relating to, or occurring on or near the surface of the earth., 21

T

U

V

APPENDIX A – AIR ASSESSMENT METHODS AND ASSUMPTIONS

A.1 Calculation of Source Terms

A.1.2 Proposed Alternative: Leave In-Place

Demmer (1996a, 1996b, 1996c, and 1997) estimated inventories of radiological and non-radiological materials remaining in the INTEC-601 facilities and INTEC-603 basins. Modelers screened radionuclide lists down to those nuclides posing 99.9% of the total radiological hazard using NCRP screening factors (NCRP 1991). Modelers assume that radiological and non-radiological contamination is intermixed and that it behaves similarly with respect to resuspension during deactivation.

Initial contaminant inventories were divided to reflect that deactivation will consist of a combination of decontamination, contaminant stabilization with fixatives, removal, and grouting, each with a different release fraction (RF). The following are initial assumptions regarding the INTEC-601 Complex source-term:

- 70% of the contaminant inventory is in below-grade vessels and cells
- Of the 70% below-grade, 50% (or 35% of the total contaminant inventory) is in RCRA units
- Of the 30% above grade, 75% (or 22.5% of the total contaminant inventory) is in the PM area and above-grade portions of P, Q, and R cells
- 7.5% of the inventory is in above-grade portions exclusive of the PM area and above-grade portions of P, Q, and R cells

The first two assumptions also apply to INTEC-603 Complex. These assumptions are conservative from an air emissions standpoint -- in that a higher percentage of contaminant inventory is assumed above-grade and subject to the disturbance of removal activities -- than is likely the case. Note that for groundwater modeling supporting the risk assessment for this project, modelers assumed that 85% of the contaminant inventory is below grade, a conservative assumption from a groundwater-modeling standpoint.

For removal activities involving contaminated materials, modelers assumed the following:

- 1/3 of the contaminant inventory would be removed by dry decontamination techniques (such as CO2 pellet-blasting and scabbling)
- 1/3 removed by wet techniques
- 1/3 stabilized with fixatives before demolition.

A.1.2 Alternative Process: Removal

The alternative process of removing the entire facility would generate greater emissions because of the increased handling and disturbance of contaminated materials. As for removal activities in the preferred process, modelers assumed that 1/3 of the contamination would be removed by dry decontamination techniques, 1/3 by wet techniques, and 1/3 stabilized with fixatives before demolition.

A.1.3 Resuspension Fractions

For resuspension during dry decontamination, modelers assumed a RF of $1x10^{-3}$, per 40 CFR 62, Appendix D. Modelers expected the fixed contamination to behave similarly to solid material, and a RF of $1x10^{-6}$, per 40 CFR 61, Appendix D, would seem an appropriate release fraction to use. However, the nature of the demolition process, e.g., compacting the material with track-mounted heavy equipment, is expected to increase this fraction; therefore, $1x10^{-3}$ is assumed for this analysis. DOE (1994) was consulted to estimate resuspension of respirable particulates from wet decontamination and from grouting, For wet decontamination, conservative, bounding values for the airborne release fraction and respirable fraction for free-fall spills of aqueous solutions with densities near 1 are $2x10^{-4}$ and $5x10^{-1}$, respectively; the product equaling an RF of $1x10^{-4}$. For free-fall spills of solutions with densities greater than 1 g/cc (similar to grouting), a conservative bounding value for the airborne release fraction is $2x10^{-5}$, with a respirable fraction of 1.0. RF is therefore $2x10^{-5}$.

A.2 Ventilation

For all deactivation alternatives, the existing primary ventilation systems for the INTEC-601 facilities would be active during the initial closure activities. These systems maintain negative air pressure within the facilities and exhaust to the west, east, or south vent tunnels, through the INTEC-649/659 filtration system and out the INTEC-708 (main) stack. Modelers credited the one stage of pre-filters and one stage of HEPA filters in INTEC 649/659 with a combined decontamination factor (DF) of $3x10^{-6}$. Modelers assumed workers would perform all decontamination of INTEC-601 facilities while the systems were active. Workers would perform all removal activities after shutting down the system. Modelers assumed the release of fugitive contaminants, unabated at ground level. Because the stack releases are orders of magnitude below ground-level releases, modelers assumed all releases at ground level.
To summarize:

- INTEC-601 facilities:
  - Decontamination releases filtered by pre-filter and HEPA filter with combined DF of $3x10^{-6}$
  - No filtration of grouting and removal releases
  - All releases assumed at ground level

- INTEC-603:
  - No filtration of releases
  - All releases assumed at ground level

A.3 Release Calculations

Atmospheric releases of radiological and non-radiological contaminants from all alternatives are calculated according to the following:

$$R_i = M_i \times (\sum_{j=1}^{n} (IF_j \times RF_j \times DF_j))$$

Where:

R_i = Mass of Contaminant i released to atmosphere
Mi = Mass of contaminant i in building
IF_j = Contaminant Inventory fraction subjected to decontamination or removal method j
RF_j = Release fraction for decontamination or removal method j
DF_j = Decontamination factor of APS filters for decontamination or removal method j

Table 16 andTable 17 summarize values assigned to inventory fractions, release fractions, and decontamination factors for the various stages of alternatives and sub-alternatives. Modelers assumed that all releases occur over a one-year period, although it is expected to take four to six years to complete deactivation of these facilities.

A.3 CAP-88 Code

Modelers used the CAP-88 computer code (EPA 1990) for radiological dose analysis. CAP-88 is approved for use by the U. S. Environmental Protection Agency (EPA) for demonstrating compliance with 40 CFR 61, Subpart H, "National Emission Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities."

Ten-year average meteorological data collected at the upper level (61 m) of the Grid III meteorological tower from 1987-1996 by the National Oceanic and Atmospheric Administration (NOAA) were used as input to the CAP-88 code. Modelers incorporated calm wind periods into the lowest wind speed class. The receptor is a hypothetical maximally exposed individual living at the INEEL boundary, 13.9 km SSW of the INTEC.

Modelers used the 1990 census data to develop the population file to assess the dose to the population within an 80-km radius of the INTEC. The modeler selected the default parameter values for the CAP-88 code in this analysis for the model input.

The output from CAP-88 is the EDE, which includes the 50-year Committed Effective Dose Equivalent (CEDE) from internal exposure through the ingestion and inhalation pathways and the external EDE from ground deposition and air immersion. The dose conversion factors are from the RADRISK dosimetric database.

Cancer risk factors for workers and the public are 4×10^{-4} cancers/person-rem and 5×10^{-4} cancers/person-rem, respectively.

Table 16. Summary of Inventory and Release Fractions and Decontamination Factors for Alternatives to Deactivating INTEC-601.

Fractions / Factors[a]	Dry Decon[b]	Wet Decon[b]	Wet Decon RCRA Units[b]	Removal	Grouting	Overall Release Fraction
			Alternative 1a			
IF	0.025	0.025	0.350	0.025	0.58	-
RF	1x10-3	1x10^{-4}	1x10^{-4}	1x10^{-3}	2x10^{-5}	-
DF	3x10-6	3x10^{-6}	3x10^{-6}	1	1	-
Combined Factors	7.50x10-11	7.50x10^{-12}	1.05x10^{-10}	2.50x10^{-5}	1.15x10^{-5}	**3.65x10^{-5}**
			Alternative 1b			
IF	0.025	0.025	0.350	0.025		-
RF	1x10-3	1x10^{-4}	1x10^{-4}	1x10^{-3}	2x10^{-5}	-
DF	3x10-6	3x10^{-6}	3x10^{-6}	1	1	-
Combined Factors	7.50x10^{-11}	7.50x10^{-12}	1.05x10^{-10}	2.50x10^{-5}	1.15x10^{-5}	**2.57x10^{-4}**
			Alternative 1c			
IF	0.025	0.025	0.350	0.025	-	-
RF	1x10-3	1x10^{-4}	1x10^{-4}	1x10^{-3}	-	-
DF	3x10-6	3x10^{-6}	3x10^{-6}	1	-	-
Combined Factors	7.50x10^{-11}	7.50x10^{-12}	1.05x10^{-10}	2.50x10^{-5}	-	**2.50x10^{-5}**
			Alternative 2			
IF	0.217	0.217	0.350	0.217	-	-
RF	1x10-3	1x10^{-4}	1x10^{-4}	1x10^{-3}	-	-
DF	3x10-6	3x10^{-6}	3x10^{-6}	1	-	-
Combined Factors	6.51x10-10	6.51x10^{-11}	1.05x10^{-10}	2.17x10^{-4}	-	**2.17x10^{-4}**

a. IF = Inventory Fraction, RF = Release Fraction, DF = Decontamination Factor for roughing and HEPA filters in APS.
b. Calculations assume that APS is operational during all activities.

Table 17. Summary of Inventory and Release Fractions for Alternatives to Deactivate INTEC-603.

Fractions/ Factors[a]	Dry Decon	Wet Decon	Removal	Grouting	Overall Release Fraction
			Alternative 1d		
IF	0.10	0.10	0.10	0.70	
RF	1x10^{-3}	1x10^{-4}	1x10^{-3}	2x10^{-5}	
Combined Factors	1x10^{-4}	1x10^{-5}		1.4x10^{-5}	**2.24x10^{-4}**
			Alternative 2		
IF	0.33	0.33	0.33		
RF	1x10^{-3}	1x10^{-4}	1x10^{-3}		
Combined Factors	3.30x10^{-4}	3.30x10^{-5}	3.30x10^{-4}		**6.93x10^{-4}**

a. Inventory Fraction, RF = Release Fraction.

Table 18. Radiological releases from alternatives to deactivation/removal of CPP-601 facilities.

Nuclide	Ci in INTEC-601	Alternative 1a Ci Released	Alternative 1b Ci Released	Alternative 1c Ci Released	Alternative 2 Ci Released
Am-241	$2.63x10^{1}$	$9.60x10^{-4}$	$6.76x10^{-3}$	$6.58x10^{-4}$	$5.71x10^{-3}$
Ce-144	$6.83x10^{2}$	$2.49x10^{-2}$	$1.76x10^{-1}$	$1.71x10^{-2}$	$1.48x10^{-1}$
Cs-134	$9.91x10^{1}$	$3.62x10^{-3}$	$2.55x10^{-2}$	$2.48x10^{-3}$	$2.15x10^{-2}$
Cs-137	$3.86x10^{2}$	$1.41x10^{-2}$	$9.92x10^{-2}$	$9.65x10^{-3}$	$8.38x10^{-2}$
Ba-137m	$3.73x10^{2}$	$1.36x10^{-2}$	$9.59x10^{-2}$	$9.33x10^{-3}$	$8.09x10^{-2}$
Eu-154	$7.69x10^{0}$	$2.81x10^{-4}$	$1.98x10^{-3}$	$1.92x10^{-4}$	$1.67x10^{-3}$
H-3	$1.44x10^{0}$	$5.26x10^{-5}$	$3.70x10^{-4}$	$3.60x10^{-5}$	$3.12x10^{-4}$
I-129	$1.83x10^{-2}$	$6.68x10^{-7}$	$4.70x10^{-6}$	$4.58x10^{-7}$	$3.97x10^{-6}$
Nb-95	$8.08x10^{1}$	$2.95x10^{-3}$	$2.08x10^{-2}$	$2.02x10^{-3}$	$1.75x10^{-2}$
Pm-147	$3.12x10^{2}$	$1.14x10^{-2}$	$8.02x10^{-2}$	$7.80x10^{-3}$	$6.77x10^{-2}$
Pu-238	$5.94x10^{0}$	$2.17x10^{-4}$	$1.53x10^{-3}$	$1.49x10^{-4}$	$1.29x10^{-3}$
Pu-239	$3.00x10^{-2}$	$1.10x10^{-6}$	$7.71x10^{-6}$	$7.50x10^{-7}$	$6.51x10^{-6}$
Pu-241	$2.79x10^{0}$	$1.02x10^{-4}$	$7.17x10^{-4}$	$6.98x10^{-5}$	$6.05x10^{-4}$
Ru-106	$5.87x10^{1}$	$2.14x10^{-3}$	$1.51x10^{-2}$	$1.47x10^{-3}$	$1.27x10^{-2}$
Rh-106	$5.87x10^{1}$	$2.14x10^{-3}$	$1.51x10^{-2}$	$1.47x10^{-3}$	$1.27x10^{-2}$
Sb-125	$4.30x10^{0}$	$1.57x10^{-4}$	$1.11x10^{-3}$	$1.08x10^{-4}$	$9.33x10^{-4}$
Te-125m	$1.67x10^{0}$	$6.10x10^{-5}$	$4.29x10^{-4}$	$4.18x10^{-5}$	$3.62x10^{-4}$
Sr-90	$3.84x10^{2}$	$1.40x10^{-2}$	$9.87x10^{-2}$	$9.60x10^{-3}$	$8.33x10^{-2}$
Y-90	$3.84x10^{2}$	$1.40x10^{-2}$	$9.87x10^{-2}$	$9.60x10^{-3}$	$8.33x10^{-2}$
Zr-95	$3.79x10^{1}$	$1.38x10^{-3}$	$9.74x10^{-3}$	$9.48x10^{-4}$	$8.22x10^{-3}$

Table 19. Radiological releases from alternatives to deactivation/removal of CPP-603.

Nuclide	Total Ci in 603	Alternative 1d Ci resuspended and released	Alternative 2 Ci resuspended and released
Ba-137m	$2.37x10^{3}$	$5.30x10^{-1}$	$1.64x10^{0}$
Cm-244	$3.40x10^{1}$	$7.62x10^{-3}$	$2.36x10^{-2}$
Co-60	$7.02x10^{-1}$	$1.57x10^{-4}$	$4.86x10^{-4}$
Cs-137	$2.49x10^{3}$	$5.58x10^{-1}$	$1.73x10^{0}$
Eu-152	$5.74x10^{2}$	$1.29x10^{-1}$	$3.98x10^{-1}$
Eu-154	$3.23x10^{2}$	$7.23x10^{-2}$	$2.24x10^{-1}$
Eu-155	$3.13x10^{1}$	$7.01x10^{-3}$	$2.17x10^{-2}$
Nb-94	$1.30x10^{0}$	$2.91x10^{-4}$	$9.01x10^{-4}$
Pu-238	$7.20x10^{-1}$	$1.61x10^{-4}$	$4.99x10^{-4}$
Pu-239	$2.26x10^{0}$	$5.06x10^{-4}$	$1.57x10^{-3}$
Sb-125	$1.00x10^{1}$	$2.24x10^{-3}$	$6.93x10^{-3}$
Sr-90	$8.71x10^{1}$	$1.95x10^{-2}$	$6.04x10^{-2}$
Te-125m	$2.50x10^{0}$	$5.60x10^{-4}$	$1.73x10^{-3}$
U-234	$3.03x10^{-1}$	$6.79x10^{-5}$	$2.10x10^{-4}$
Y-90	$8.71x10^{1}$	$1.95x10^{-2}$	$6.04x10^{-2}$

Table 20. Dose and Cancer Risk Summary for INTEC-601 and INTEC-603 Complex Deactivation Alternatives.

	INTEC-601							
	Alternative 1a		Alternative 1b		Alternative 1c		Alternative 2	
Receptor	Dose	Cancer Risk	Dose	Cancer Risk	Dose	Cancer Risk	Dose	Cancer Risk
	INTEC-601							
MEI	1.2×10^{-2}	6.0×10^{-9}	8.4×10^{-2}	4.2×10^{-8}	8.2×10^{-3}	4.1×10^{-9}	7.1×10^{-2}	3.6×10^{-8}
Worker at 100-m	1.5×10^{1}	6.2×10^{-6}	1.1×10^{2}	4.4×10^{-5}	1.1×10^{1}	4.2×10^{-6}	9.2×10^{1}	3.7×10^{-5}
Population	4.3×10^{-2}	2.2×10^{-5}	3.1×10^{-1}	1.5×10^{-4}	3.0×10^{-2}	1.5×10^{-5}	2.6×10^{-1}	1.3×10^{-4}
	INTEC-603							
	Alternative 1d						Alternative 2	
MEI	8.7×10^{-2}	4.3×10^{-8}					2.7×10^{-1}	1.3×10^{-7}
Worker at 100-m	9.4×10^{1}	3.8×10^{-5}					2.9×10^{2}	1.2×10^{-4}
Population	3.2×10^{-1}	1.6×10^{-4}					9.9×10^{-1}	5.0×10^{-4}

a. Dose in mrem/yr. For MEI and worker; person-rem for population.

Table 21. Non-Radiological Contaminants in Intec-601 Facilities: Estimated Releases and Concentrations Compared to Standards.[a]

	Alternative 1a		Alternative 1b		Alternative 1c		Alternative 2				
Contaminant	Mass (mg) resuspended and released	lb/hr released	Mass (mg) resuspended and released	lb/hr released	Mass (mg) resuspended and released	lb/hr released	Mass (mg) resuspended and released	lb/hr released	Idaho Emission Limit (lb/hr)	Alternative 1b Concentration at MSB ($\mu g/m^3$)[a]	Idaho AACC ($\mu g/m^3$)
Aluminum	2.67×10^{3}	2.83×10^{-6}	1.88×10^{4}	1.99×10^{-5}	1.83×10^{3}	1.94×10^{-6}	1.59×10^{4}	1.68×10^{-5}	1.33×10^{-1}		
Ammonia	4.16×10^{0}	4.40×10^{-9}	2.93×10^{1}	3.10×10^{-8}	2.85×10^{0}	3.01×10^{-9}	2.47×10^{1}	2.62×10^{-8}	1.20×10^{0}		
Boron	3.72×10^{1}	3.94×10^{-8}	2.62×10^{2}	2.77×10^{-7}	2.55×10^{1}	2.70×10^{-8}	2.21×10^{2}	2.34×10^{-7}	2.00×10^{-1}		
Cadmium	7.92×10^{2}	8.38×10^{-7}	5.58×10^{3}	5.90×10^{-6}	5.43×10^{2}	5.74×10^{-7}	4.71×10^{3}	4.98×10^{-6}	3.70×10^{-6}	8.85×10^{-8}	5.60×10^{-4}
Calcium	3.80×10^{0}	4.02×10^{-9}	2.67×10^{1}	2.83×10^{-8}	2.60×10^{0}	2.75×10^{-9}	2.26×10^{1}	2.39×10^{-8}	1.33×10^{-1}		
Chlorine	3.22×10^{3}	3.41×10^{-6}	2.27×10^{4}	2.40×10^{-5}	2.21×10^{3}	2.33×10^{-6}	1.92×10^{4}	2.03×10^{-5}	2.00×10^{-1}		
Chromium	1.02×10^{1}	1.08×10^{-8}	7.17×10^{1}	7.58×10^{-8}	6.98×10^{0}	7.38×10^{-9}	6.05×10^{1}	6.40×10^{-8}	3.30×10^{-2}		
Fluoride	1.15×10^{3}	1.22×10^{-6}	8.10×10^{3}	8.56×10^{-6}	7.88×10^{2}	8.33×10^{-7}	6.84×10^{3}	7.23×10^{-6}	1.67×10^{-1}		
4-Methyl^{-2}-pentanone	2.58×10^{0}	2.73×10^{-9}	1.82×10^{1}	1.92×10^{-8}	1.77×10^{0}	1.87×10^{-9}	1.54×10^{1}	1.62×10^{-8}	1.37×10^{1}		
Iron	5.26×10^{1}	5.56×10^{-8}	3.70×10^{2}	3.91×10^{-7}	3.60×10^{1}	3.81×10^{-8}	3.12×10^{2}	3.31×10^{-7}	6.70×10^{-2}		
Molybdenum	4.38×10^{-1}	4.63×10^{-10}	3.08×10^{0}	3.26×10^{-9}	3.00×10^{-1}	3.17×10^{-10}	2.60×10^{0}	2.75×10^{-9}	3.33×10^{-1}		
Nickel	4.38×10^{0}	4.63×10^{-9}	3.08×10^{1}	3.26×10^{-8}	3.00×10^{0}	3.17×10^{-9}	2.60×10^{1}	2.75×10^{-8}	2.70×10^{-5}	4.89×10^{-10}	4.20×10^{-3}
Potassium	5.55×10^{3}	5.87×10^{-6}	3.91×10^{4}	4.13×10^{-5}	3.80×10^{3}	4.02×10^{-6}	3.30×10^{4}	3.49×10^{-5}	1.33×10^{-1}		
Tin	4.67×10^{0}	4.94×10^{-9}	3.29×10^{1}	3.48×10^{-8}	3.20×10^{0}	3.38×10^{-9}	2.78×10^{1}	2.94×10^{-8}	7.00×10^{-3}		
Tributylphosphate	2.39×10^{2}	2.53×10^{-7}	1.68×10^{3}	1.78×10^{-6}	1.64×10^{2}	1.73×10^{-7}	1.42×10^{3}	1.50×10^{-6}	1.47×10^{-1}		
Uranium	3.98×10^{1}	4.21×10^{-8}	2.80×10^{2}	2.96×10^{-7}	2.73×10^{1}	2.88×10^{-8}	2.37×10^{2}	2.50×10^{-7}	1.30×10^{-2}		
Zirconium	4.53×10^{2}	4.79×10^{-7}	3.19×10^{3}	3.37×10^{-6}	3.10×10^{2}	3.28×10^{-7}	2.69×10^{3}	2.85×10^{-6}	3.33×10^{-1}		

a. Based on ground level release, 0.015 ug/m3 per lb/hr release rate (Abbott, 1996)

Table 22. Non-radiological contaminants in INTEC-603: Estimated releases and concentrations compared to standards.[a]

	Alternative 1d		Alternative 2						
Contaminant	Mass (mg) resuspended and released	lb/hr released from 603	Mass (mg) resuspended and released	lb/hr released from 603	Idaho Emission Limit (lb/hr)	Alternative 2 Concentration at MSB (ug/m^3)[a]	Idaho AACC (ug/m^3)	Concentration at nearest ambient receptor (ug/m^3)	Idaho Priority Pollutant limit (ug/m^3)
Aluminum	$1.40x10^{6}$	$1.48x10^{-3}$	$4.33x10^{6}$	$4.58x10^{-3}$	$1.33x10^{-1}$				
Arsenic	$4.73x10^{2}$	$5.01x10^{-7}$	$1.46x10^{3}$	$1.55x10^{-6}$	$1.50x10^{-6}$	$2.32x10^{-8}$	$2.30x10^{-4}$		
Barium	$4.37x10^{3}$	$4.62x10^{-6}$	$1.35x10^{4}$	$1.43x10^{-5}$	$3.30x10^{-2}$				
Cadmium	$5.42x10^{3}$	$5.73x10^{-6}$	$1.68x10^{4}$	$1.77x10^{-5}$	$3.70x10^{-6}$	$2.66x10^{-7}$	$5.60x10^{-4}$		
Chromium	$1.65x10^{4}$	$1.74x10^{-5}$	$5.09x10^{4}$	$5.39x10^{-5}$	$3.30x10^{-2}$				
Lead	$2.13x10^{4}$	$2.25x10^{-5}$	$6.58x10^{4}$	$6.96x10^{-5}$				$6.06x10^{-5}$	$1.00x10^{-1}$
Mercury	$2.14x10^{0}$	$2.26x10^{-9}$	$6.62x10^{0}$	$7.00x10^{-9}$	$1.00x10^{-3}$				
Nickel	$3.45x10^{2}$	$3.65x10^{-7}$	$1.07x10^{3}$	$1.13x10^{-6}$	$2.70x10^{-5}$	$1.69x10^{-8}$	$4.20x10^{-3}$		
Selenium	$1.63x10^{2}$	$1.73x10^{-7}$	$5.05x10^{2}$	$5.34x10^{-7}$	$1.30x10^{-2}$				
Silver	$1.03x10^{1}$	$1.09x10^{-8}$	$3.19x10^{1}$	$3.38x10^{-8}$	$1.00x10^{-3}$				
Uranium	$1.90x10^{4}$	$2.01x10^{-5}$	$5.88x10^{4}$	$6.22x10^{-5}$	$1.30x10^{-2}$				
Zinc	$3.20x10^{4}$	$3.39x10^{-5}$	$9.91x10^{4}$	$1.05x10^{-4}$	$3.33x10^{-1}$				
Acetone	$6.61x10^{1}$	$6.99x10^{-8}$	$2.04x10^{2}$	$2.16x10^{-7}$	$1.19x10^{2}$				
Benzene	$2.42x10^{0}$	$2.56x10^{-9}$	$7.48x10^{0}$	$7.92x10^{-9}$	$8.00x10^{-4}$	$1.19x10^{-10}$	$1.20x10^{-1}$		
2-Butanone	$1.50x10^{0}$	$1.59x10^{-9}$	$4.64x10^{0}$	$4.91x10^{-9}$	$3.93x10^{1}$				
1,2-Dichloroethane	$7.39x10^{-1}$	$7.82x10^{-10}$	$2.29x10^{0}$	$2.42x10^{-9}$	$2.70x10^{1}$	3.63x10-11	$3.80x10^{-2}$		
Methylene Chloride	$7.39x10^{-1}$	$7.82x10^{-10}$	$2.29x10^{0}$	$2.42x10^{-9}$	$1.60x10^{-3}$	3.63x10-11	$2.40x10^{-1}$		
4-Methyl-2-pentanone	$1.23x10^{0}$	$1.30x10^{-9}$	$3.81x10^{0}$	$1.04x10^{-9}$	$1.37x10^{1}$				
Styrene	$8.51x10^{-1}$	$9.00x10^{-10}$	$2.63x10^{0}$	$7.19x10^{-10}$	$6.67x10^{0}$				
Toluene	$1.43x10^{0}$	$1.52x10^{-9}$	$4.44x10^{0}$	$1.21x10^{-9}$	$2.50x10^{1}$				
Xylene	$2.37x10^{0}$	$2.51x10^{-9}$	$7.35x10^{0}$	$2.01x10^{-9}$	$7.00x10^{-4}$				

a. Based on ground level release, 0.015 ug/m3 per lb/hr release rate (Abbott, 1996)

APPENDIX B – RISK ASSESSMENT METHODOLOGY

B.1 Risk Characterization Methodology

The methodology used to calculate the effects from exposure to the contaminants of potential concern (COPCs) in the INTEC-601 and INTEC-603 Complexes is presented in the following sections.

B.1.1 Carcinogens

For the radioactive carcinogens, risks represent the incremental probability of an individual developing fatal cancer over a lifetime because of exposure to carcinogens. The general form of the risk equation for radioactive carcinogens is to multiply the intake by the COPC-specific toxicity value (EPA 1989):

$$Risk = I x SF$$

where,

Risk = cancer risk, expressed as a unitless probability
I = intake (pCi or pCi-yr./gram)
SF = slope factor [$(pCi)^{-1}$ or $(gram/pCi\text{-}yr.)^{-1}$]

Quantitative risks for the external exposure pathway were determined using the **RESRAD** computer code for the INTEC-603 risk assessment and the **Microshield** computer program for the INTEC-601 Complex risk assessment. Risks for the groundwater ingestion exposure pathway were calculated using the computer code **GWSCREEN**.

B.1.2 Non-carcinogens

For the non-carcinogens such as the non-radionuclides, hazard quotients measure the potential for adverse effects. A hazard quotient is the ratio of the estimated intake over the RfD as presented below (EPA 1989):

$$HQ = {}^{I}\!/_{RfD}$$

where,

HQ = hazard quotient
I = intake (mg/kg-d)
RfD = reference dose (mg/kg-d)

Modelers calculated the hazard quotients for the groundwater-ingestion exposure pathway using the computer code GWSCREEN. If the hazard index (the sum of more than one hazard quotient) is greater than one, there may be concern for the potential non-carcinogenic effects because the intake exceeds the reference dose. If the hazard index is less than one, then modelers presume the estimated soil concentration of the metal is below the threshold of potential non-carcinogenic effects, and expect no adverse health effects from exposure to the metal.

Lead bricks and shielding in INTEC-601 Complex were not quantitatively evaluated because of their physical form, the exposure pathways evaluated, and the grouting of the building. This could slightly underestimate the risk if lead were released from the bricks or shielding, and diffused through the concrete grout.

The lead was not included in the risk assessment because the Environmental Protection Agency does not have a toxicity value for ingestion of this substance. The physical form of the lead bricks, a solid, reduces the likelihood that they would enter a pathway leading to ingestion.

B.2 Hazardous and Radionuclide Concentrations and Risk for Deactivating by Grouting In-Place Above Ground the INTEC-601 Complex (Alternative 1a) and Deactivating by Grouting In-Place to Ground Level the INTEC-603 Complex (Alternative 1d)

B.2.1 External Radiation Exposure

The external exposure pathway was evaluated for both INTEC-601 and INTEC-603 Complexes. The risk from external exposure at INTEC-601 Complex was calculated using the Microshield computer program due to the fact that part of the grouting will be above grade. This program yields a total exposure in mRem/hr from which a total risk is calculated rather than calculating risks resulting from each specific radionuclide. Microshield calculated an external exposure that resulted in a total risk of $3x10^{-9}$ that is less than the lower limit of the NCP target risk range, $1x10^{-6}$.

Table 23 shows the cancer risk from external exposure at INTEC-603. Because all the contaminants are below grade, modelers used RESRAD for this calculation. As can be seen from the Table, all risks are at least one order of magnitude lower than the lower limit of the NCP target risk range, $1x10^{-6}$.

B.2.1 Groundwater Ingestion Exposures

Table 24 andTable 25 show the peak groundwater concentrations, time of maximum concentrations and the limiting contaminant levels for INTEC-601 Complex and INTEC-603 Complex, respectively. There are a total of three non-radionuclide and fourteen radionuclide contaminants for INTEC-601 Complex and a total of eight non-radionuclide and nine radionuclide contaminants for the INTEC-603 Complex.

Table 26 shows the predicted concentrations and time of maximum concentrations using the refined groundwater model for radionuclides whose predicted maximum water concentrations exceeded their limiting concentrations. These COPC include I-129, Sm-151, and Sr-90 for INTEC-601 Complex and Nb-94, $Pu^{-2}39$, Sr-90, $U^{-2}34$, and $U^{-2}35$ for INTEC-603. For a complete discussion of methods and assumptions used to calculate these values, refer to Stepan and McCarthy 1997, 1998).

The calculated radionuclide concentrations potentially available to the soil from INTEC-601 Complex and INTEC-603 Complex (see Table 26) are compared (Table 27) with the proposed Drinking Water Standards (see 40 CFR Parts 141 and 142).

Table 28 shows the cancer risk from groundwater ingestion for the eight radionuclides in INTEC-601 Complex and INTEC-603 Complex using the GWSCREEN and the refined risk models. Table 33 shows the risks from the same eight radionuclides compared to the results from the WCF risk assessment (see Rood 1996) and the High Level Waste no action risk assessment for the Tank Farm (Stepan and McCarthy 1997).

B.3 Hazardous and Radionuclide Concentrations and risk for Deactivating by Grouting In-Place to Ground Level the INTEC-601 Complex (Alternative 1b)

It is assumed that 15% of the current COPC inventory in the INTEC-601 Complex will be removed by taking the structure down to ground level. Modelers assume that for the groundwater calculations, the thickness of the contaminated zone (3 m) is the same as that for the proposed action (Alternative 1a). This is because 3 m is a conservative value for the thickness for both assessments. Because of these assumptions, the results of this option will be 85% of that of the proposed alternative. Table 29 shows the peak groundwater concentrations, time of maximum concentrations, and the limiting contaminant levels for this alternative at the INTEC-601 Complex. Table 30 shows the predicted concentrations and time of maximum concentrations using the refined groundwater model for the two radionuclides in Table 29 (I-129 and Sm-151), whose predicted maximum waster concentrations exceeded their limiting concentrations. For a complete discussion of methods and assumptions, refer to Stepan and McCarthy 1997, 1998).

The calculated radionuclide concentrations potentially available to the soil from Deactivating the INTEC-601 Complex (see Table 29) are compared (Table 31) with the proposed Drinking Water Standards (see 40 CFR Parts 141 and 142). Table 32 shows the cancer risk from groundwater ingestion for the two radionuclides in the INTEC-601 Complex and the five radionuclides from the INTEC-603 Complex using GWSCREEN and the refined risk model. Table 33 shows the risk from the same seven radionuclides at these facilities compared to the results from the WCF risk assessment (see Rood et al. 1996) and the High-Level Waste no action risk assessment for the Tank Farm (Stepan and McCarthy 1997).

Table 23. External exposure pathway risks for the 100-year residential scenario at the INTEC-603 Complex[a].

Contaminant	External Exposure Pathway Risk	
	INTEC-603 Complex	SFE-106[b]
Am^{-2}41	$<1x10^{-30}$	$3x10^{-26}$
Co-58	[c]	[d]
Co-60	$<1x10^{-30}$	$1x10^{-14}$
Cs-134	$<1x10^{-30}$	$9x10^{-26}$
Cs-137	$<1x10^{-30}$	$2x10^{-8}$
Cm^{-2}44	$<1x10^{-30}$	NA
Eu-152	$2x10^{-27}$	$2x10^{-10}$
Eu-154	$1x10^{-29}$	$5x10^{-12}$
Eu-155	$<1x10^{-30}$	na
Nb-94	$<1x10^{-30}$	$1x10^{-10}$
Np^{-2}37	$<1x10^{-30}$	NA
Pu^{-2}38	$<1x10^{-30}$	$8x10^{-27}$
Pu^{-2}39	$<1x10^{-30}$	$1x10^{-26}$
Sb-125	$<1x10^{-30}$	$1x10^{-22}$
Sr-90	$<1x10^{-30}$	$<1x10^{-30}$
Th^{-2}28	$<1x10^{-30}$	$3x10^{-26}$
Th^{-2}30	[d]	$1x10^{-28}$
U^{-2}34	$<1x10^{-30}$	[d]
U^{-2}35	$<1x10^{-30}$	$2x10^{-19}$
U^{-2}36	$<1x10^{-30}$	[c]
U^{-2}38	$<1x10^{-30}$	$2x10^{-15}$
Total	$2x10^{-27}$	$2x10^{-8}$

a. The total external exposure risk at the INTEC-601 Complex was calculated at $3x10^{-9}$.
b. Solid Waste Collection Tank under RCRA Interim Status.
c. No RESRAD data available for Co-58, therefore, a risk was not calculated.
d. Not applicable, radionuclide not detected in this area.

Table 24. Initial model results (using GWSCREEN) for the Deactivating By-Grouting In-Place to Above Ground Level the INTEC-601 Complex (Alternative 1a). Contaminants shown in bold and with an "*" have predicted peak concentrations greater than the limiting concentrations and were modeled using the refined groundwater model[a]

Contaminant	Daughters	Limiting Concentration (mg/L or pCi/L)	Time to Peak Conc. (Years)	Peak Concentration (mg/L or pCi/L)
			Non-Radionuclide	
Cadmium		1.85X10^{-2}	283	8.09X10^{-5}
Chloride		3.70X10^{0}	10.1	1.02X10^{-2}
Fluoride		2.20X10^{0}	10.1	3.64X10^{-3}
			Radionuclide	
Am^{-2}41		1.46X10^{-1}	4,090	8.77X10^{-6}
	Np^{-2}37	1.60X10^{-1}		4.87X10^{-5}
	U^{-2}33	1.07X10^{0}		9.48X10^{-7}
	Th^{-2}29	1.35X10^{-1}		9.51X10^{-9}
H-3		6.71X10^{2}	8.84	9.78X10^{1}
I-129*		**2.61X10^{-1}**	**10.1**	**2.11X10^{0}**
Np^{-2}37		1.60X10^{-1}	374	4.79X10^{-3}
	U^{-2}33	1.07X10^{0}		1.01X10^{-5}
	Th^{-2}29	1.34X10^{-1}		1.20X10^{-9}
Pu^{-2}38		1.63X10^{-1}	420	6.00X10^{-2}
	U^{-2}34	1.08X10^{0}		1.91X10^{-3}
	Th^{-2}30	1.28X10^{0}		3.65X10^{-7}
	Ra^{-2}26	1.62X10^{-1}		2.54X10^{-8}
	Pb^{-2}10	4.75X10^{-2}		2.12X10^{-8}
Pu^{-2}39		1.52X10^{-1}	999	3.03X10^{-2}
	U^{-2}35	1.02X10^{0}		1.02X10^{-7}
	Pa^{-2}31	3.19X10^{-1}		1.32X10^{-11}
	Ac^{-2}27	7.60X10^{-2}		1.52X10^{-11}
Pu^{-2}40		1.52X10^{-1}	975	1.38X10^{-2}
	U^{-2}36	1.14X10^{0}		1.41X10^{-6}
	Th^{-2}32	1.45X10^{0}		2.33X10^{-15}
	Ra^{-2}28	b		2.29X10^{-15}
	Th^{-2}28	2.08X10^{-1}		2.28X10^{-15}
Pu^{-2}41		9.23X10^{0}	258	2.78X10^{-7}
	Am^{-2}41	1.46X10^{-1}		1.06X10^{-4}
	Np^{-2}37	1.60X10^{-1}		3.83X10^{-7}
	U^{-2}33	1.07X10^{0}		2.75X10^{-10}
	Th^{-2}29	1.35X10^{-1}		1.44X10^{-14}
Sm-151*		**1.04X10^{2}**	**9.87**	**3.55X10^{2}**
Sn-126		2.26X10^{0}	10.1	1.65X10^{-1}
Sr-90*		**8.59X10^{-1}**	**189**	**9.89X10^{-1}**
U^{-2}34		1.07X10^{0}	283	2.91X10^{-3}
	Th^{-2}30	1.27X10^{0}		5.09X10^{-7}
	Ra^{-2}26	1.61X10^{-1}		3.00X10^{-8}
	Pb^{-2}10	4.71X10^{-2}		2.40X10^{-8}
U^{-2}35		1.02X10^{0}	283	4.62X10^{-3}
	Pa^{-2}31	3.19X10^{-1}		3.39X10^{-7}
	Ac^{-2}27	7.60X10^{-2}		3.68X10^{-9}
U^{-2}36		1.14X10^{0}	283	1.07X10^{-2}
	Th^{-2}32	1.45X10^{0}		1.00X10^{-11}
	Ra^{-2}28	b		9.75X10^{-12}
	Th^{-2}28	2.08X10^{-1}		9.66X10^{-12}

a. See Table 26.

b. Not applicable, radionuclide not detected in this area.

Table 25. Initial model results (using GWSCREEN) for the Deactivating By-Grouting In-Place to Ground Level the INTEC-603 Complex (Alternative 1d). Contaminants shown in bold and with an "*" have predicted peak concentrations greater than the limiting concentrations and were modeled using the refined groundwater model[a]

Contaminant	Daughters	Limiting Concentration (mg/L or pCi/L)	Time to Peak Conc. (Years)	Peak Concentration (mg/L or pCi/L)
		Non-Radionuclide		
Arsenic		$5.68X10^{-5}$	146	$1.53X10^{-5}$
Benzene		$2.94X10^{-3}$	19.2	$6.24X10^{-7}$
Beryllium		$1.98X10^{-5}$	11370	$3.48X10^{-9}$
Cadmium		$1.85X10^{-2}$	283	$9.02X10^{-5}$
Chromium		$1.83X10^{-1}$	64.6	$1.21X10^{-3}$
Lead		$1.50X10^{-2}$	4554	$2.23X10^{-5}$
Uranium		$1.10X10^{-1}$	283	$3.16X10^{-4}$
Zinc		$1.10X10^{1}$	737	$2.04X10^{-3}$
		Radionuclide		
Nb-94*		**$6.89X10^{0}$**	**268**	**$2.20X10^{1}$**
Np^{-2}37		$1.60X10^{-1}$	269	$9.38X10^{-2}$
	U^{-2}33	$1.07X10^{0}$		$1.43X10^{-4}$
	Th^{-2}29	$1.35X10^{-1}$		$1.21X10^{-7}$
Pu^{-2}39*		**$1.52X10^{-1}$**	**722**	**$1.40X10^{1}$**
	U^{-2}35	$1.02X10^{0}$		$3.37X10^{-5}$
	Pa^{-2}31	$3.19X10^{-1}$		$3.16X10^{-9}$
	Ac^{-2}27	$7.60X10^{-2}$		$3.54X10^{-9}$
Sr-90*		**$8.59X10^{-1}$**	**145**	**$7.04X10^{0}$**
Th^{-2}30		$1.27X10^{0}$	324	$1.35X10^{-3}$
	Ra^{-2}26	$1.61X10^{-1}$		$1.03X10^{-3}$
	Pb^{-2}10	$4.71X10^{-2}$		$1.03X10^{-3}$
U^{-2}34*		**$1.07X10^{0}$**	**204**	**$6.83X10^{0}$**
	Th^{-2}30	$1.27X10^{0}$		$8.60X10^{-4}$
	Ra^{-2}26	$1.61X10^{-1}$		$3.69X10^{-5}$
	Pb^{-2}10	$4.71X10^{-2}$		$2.71X10^{-5}$
U^{-2}35*		**$1.02X10^{0}$**	**204**	**$2.55X10^{0}$**
	Pa^{-2}31	$3.19X10^{-1}$		$1.35X10^{-4}$
	Ac^{-2}27	$7.60X10^{-2}$		$1.40X10^{-4}$
U^{-2}36		$1.14X10^{0}$	204	$1.01X10^{-2}$
	Th^{-2}32	$1.45X10^{0}$		$6.89X10^{-12}$
	Ra^{-2}28	na		$6.61X10^{-12}$
	Th^{-2}28	$2.08X10^{-1}$		$6.52X10^{-12}$
U^{-2}38		$7.68X10^{-1}$	204	$8.12X10^{-2}$
	U^{-2}34	$1.07X10^{0}$		$4.68X10^{-5}$
	Th^{-2}30	$1.27X10^{0}$		$2.95X10^{-9}$
	Ra^{-2}26	$1.61X10^{-1}$		$8.48X10^{-11}$
	Pb^{-2}10	$4.71X10^{-2}$		$5.54X10^{-11}$

a. See Table 26

b. Not applicable, radionuclide not detected in this area.

Table 26. Refined Groundwater Model results for Deactivating By Grouting In-Place Above Ground the INTEC-601 Complex (Alternative 1a) and INTEC-603 Complex (Alternative 1d). Model analysis based on a concrete source area. The contaminants retained have predicted peak concentrations greater than the limiting concentrations.

Radionuclides	Daughters	Inventory in 100 years (Ci)	Limiting Concentration (pCi/L)	Time (from 100 years) to Peak Concentration (yr)	Peak Concentration (pCi/L)
			INTEC-601 Complex		
I-129		0.0183	$2.61X10^{-1}$	25.4	$1.07X10^{-1}$
Sm-151		1.54	$1.04X10^{2}$	9.88	$1.65X10^{2}$
Sr-90		34.	$8.59X10^{-1}$	174	$2.40X10^{-1}$
			INTEC-603 Complex		
Nb-94		1.30	$6.89X10^{0}$	544	$1.36X10^{1}$
$Pu^{-2}39$		2.26	$1.51X10^{-1}$	1770	$6.32X10^{0}$
	$U^{-2}35$		$1.01X10^{0}$		$3.79X10^{-5}$
	$Pa^{-2}31$		$3.19X10^{-1}$		$8.71X10^{-9}$
	$Ac^{-2}27$		$7.60X10^{-2}$		$1.03X10^{-8}$
Sr-90		7.72	$8.59X10^{-1}$	141	$6.71X10^{-1}$
$U^{-2}34$		0.303	$1.07X10^{0}$	709	$1.40X10^{0}$
	$Th^{-2}30$		$1.27X10^{0}$		$6.16X10^{-4}$
	$Ra^{-2}26$		$1.61X10^{-1}$		$8.57X10^{-5}$
	$Pb^{-2}10$		$4.71X10^{-2}$		$7.86X10^{-5}$
$U^{-2}35$		0.113	$1.01X10^{0}$	709	$5.25X10^{-1}$
	$Pa^{-2}31$		$3.19X10^{-1}$		$9.63X10^{-5}$
	$Ac^{-2}27$		$7.60X10^{-2}$		$1.12X10^{-4}$

Table 27. Comparison of estimated radionuclide concentrations to existing and proposed drinking water standards.

Radionuclides	Peak Concentration (pCi/L)	Drinking Water Standard (pCi/L)
	INTEC-601 Complex	
I-129	$1.07x10^{-1}$	$2.10x10^{1}$
Sm-151	$1.65x10^{2}$	$1.41x10^{4}$
Sr-90	$2.40x10^{-1}$	$8.00x10^{0}$a
	INTEC-603 Complex	
Nb-94	$1.36x10^{1}$b	$7.07x10^{2}$
$Pu^{-2}39$	$6.32x10^{0}$b	$6.21x10^{1}$
Sr-90	$6.71x10^{-0}$b	$8.00x10^{0}$a
$U^{-2}34$	$1.40x10^{0}$b	$1.39x10^{1}$
$U^{-2}35$	$5.25x10^{-1}$	$1.45x10^{1}$

a. From EPA, 40 CFR Parts 141 and 142, "National Primary Drinking Water Regulations."
b. From EPA, 40 CFR Parts 141 and 142, "National Primary Drinking Water Regulations; Proposed."

Table 28. Cancer risks for radionuclides in the 100-year residential groundwater ingestion pathway for the refined risk analysis.[a]

Radionuclides	Risk
	INTEC-601 Complex[b]
I-129	$4x10^{-7}$
Sm-151	$2x10^{-6}$
Sr-90	$3x10^{-7}$
Total	$3x10^{-6}$
	INTEC-603 Complex[c]
Nb-94	$2x10^{-6}$
Pu-239	$4x10^{-5}$
Sr-90	$8x10^{-7}$
U-234	$1x10^{-6}$
U-235	$5x10^{-7}$
Total	$4x10^{-5}$

a. Contamination source for the GWSCREEN runs was assumed to be at what is currently the south fence of the INTEC. This is a distance of 100 m from INTEC-603 Complex and 745 m from INTEC-601 Complex.

b. Deactivating By Grouting INTEC-601 Complex In-Place to Above Ground Level (Alternative 1a)

c. Deactivating By Grouting INTEC-603 Complex In-Place to Ground Level (Alternative 1d)

Table 29. Initial model results (using GWSCREEN) for the Deactivating By-Grouting In-Place to Ground Level the INTEC-601 Complex (Alternative 1b). Contaminants shown in bold and with an "*" have predicted peak concentrations greater than the limiting concentrations and were modeled using the refined groundwater model[a].

Contaminant	Daughters	Limiting Concentration (mg/L or pCi/L)	Time to Peak Concentration (Years)	Peak Concentration (mg/L or pCi/L)
Cadmium		1.85x10^{-2}	283	6.88x10^{-5}
Chloride		3.70x10^{0}	10.1	8.67x10^{-3}
Fluoride		2.20x10^{0}	10.1	3.09x10^{-3}
Am^{-2}41		1.46x10^{-1}	4,090	7.45x10^{-6}
	Np^{-2}37	1.60x10^{-1}		4.14x10^{-5}
	U^{-2}33	1.07x10^{0}		8.06x10^{-7}
	Th^{-2}29	1.35x10^{-1}		8.08x10^{-9}
H-3		6.71x10^{2}	8.84	8.31x10^{1}
I-129*		**2.61x10^{-1}**	**10.1**	**1.79x10^{0}**
Np^{-2}37		1.60x10^{-1}	374	4.07x10^{-3}
	U^{-2}33	1.07x10^{0}		8.59x10^{-6}
	Th^{-2}29	1.34x10^{-1}		1.02x10^{-9}
Pu^{-2}38		1.63x10^{-1}	420	5.10x10^{-2}
	U^{-2}34	1.08x10^{0}		1.62x10^{-3}
	Th^{-2}30	1.28x10^{0}		3.10x10^{-7}
	Ra^{-2}26	1.62x10^{-1}		2.16x10^{-8}
	Pb^{-2}10	4.75x10^{-2}		1.80x10^{-8}
Pu^{-2}39		1.52x10^{-1}	999	2.58x10^{-2}
	U^{-2}35	1.02x10^{0}		8.67x10^{-8}
	Pa^{-2}31	3.19x10^{-1}		1.12x10^{-11}
	Ac^{-2}27	7.60x10^{-2}		1.29x10^{-11}
Pu^{-2}40		1.52x10^{-1}	975	1.17x10^{-2}
	U^{-2}36	1.14x10^{0}		1.20x10^{-6}
	Th^{-2}32	1.45x10^{0}		1.98x10^{-15}
	Ra^{-2}28	[b]		1.95x10^{-15}
	Th^{-2}28	2.08x10^{-1}		1.94x10^{-15}
Pu^{-2}41		9.23x10^{0}	258	2.36x10^{-7}
	Am^{-2}41	1.46x10^{-1}		9.01x10^{-5}
	Np^{-2}37	1.60x10^{-1}		3.26x10^{-7}
	U^{-2}33	1.07x10^{0}		2.34x10^{-10}
	Th^{-2}29	1.35x10^{-1}		1.22x10^{-14}
Sm-151*		**1.04x10^{2}**	**9.87**	**3.02x10^{2}**
Sn-126		2.26x10^{0}	10.1	1.40x10^{-1}
Sr-90		8.59x10^{-1}	189	8.41x10^{-1}
U^{-2}34		1.07x10^{0}	283	2.47x10^{-3}
	Th^{-2}30	1.27x10^{0}		4.33x10^{-7}
	Ra^{-2}26	1.61x10^{-1}		2.55x10^{-8}
	Pb^{-2}10	4.71x10^{-2}		2.04x10^{-8}
U^{-2}35		1.02x10^{0}	283	3.93x10^{-3}
	Pa^{-2}31	3.19x10^{-1}		2.88x10^{-7}
	Ac^{-2}27	7.60x10^{-2}		3.13x10^{-9}
U^{-2}36		1.14x10^{0}	283	9.10x10^{-3}
	Th^{-2}32	1.45x10^{0}		8.50x10^{-12}
	Ra^{-2}28	[b]		8.29x10^{-12}
	Th^{-2}28	2.08x10^{-1}		8.21x10^{-12}

a. See Table 30.

b. Not applicable, radionuclide not detected in this area.

Table 30. GWSCREEN analysis of radionuclide concentrations for Deactivating By Grouting In-Place to Ground Level (Alternative 1b). Calculations based on a concrete source area.

Radionuclides	Inventory in 100 years (Ci)	Limiting Concentration (pCi/L)	Time (from 100 years) to Peak Concentration (yr)	Peak Concentration (pCi/L)
I-129	0.0183	2.61×10^{-1}	25.4	9.10×10^{-2}
Sm^{-1}51	1.54	1.04×10^{2}	9.88	1.40×10^{2}

Table 31. Comparison of radionuclide concentrations to existing and proposed drinking water standards for Deactivating By Grouting In-Place to Ground Level (Alternative 1b) of the INTEC-601 Complex.

INTEC-601 Complex Radionuclides	Peak Concentration (pCi/L)	Proposed Drinking Water Standard (pCi/L)
I-129	1.07×10^{-1}	2.10×10^{1}
Sm-151	1.65×10^{2}	1.41×10^{4}

Table 32. Cancer risks for radionuclides in the 100-year residential groundwater ingestion pathway, based on the refined risk analysis for the Deactivating By Grouting In-Place to Ground Level of INTEC-601 Complex (Alternative 1b) and INTEC-603 Complex (Alternatives 1d).

Radionuclides	Risk
	INTEC-601 Complex
I-129	3×10^{-7}
Sm-151	2×10^{-6}
Total	3×10^{-6}
	INTEC-603 Complex
Nb-94	2×10^{-6}
Pu^{-2}39	4×10^{-5}
Sr-90	8×10^{-7}
U^{-2}34	1×10^{-6}
U^{-2}35	5×10^{-7}
Total	4×10^{-5}

Table 33. Cancer risks for radionuclides in the residential groundwater ingestion pathway for INTEC-601 Complex, INTEC-603 Complex, WCF, and the HLW Tank Farm.[a]

Radionuclides	INTEC-601 Complex	INTEC-603 Complex	WCF[b]	Tank Farm[c]
Ac^{-2}27				$1x10^{-9}$
Am^{-2}41				$1x10^{-9}$
I-129	$3x10^{-7}$			$7x10^{-3}$
Nb-94		$2x10^{-6}$		
Np^{-2}37			$1x10^{-8}$	$4x10^{-4}$
Pa^{-2}31				$1x10^{-8}$
Pb^{-2}10				$3x10^{-5}$
Pu^{-2}39		$4x10^{-5}$	$5x10^{-9}$	
Pu^{-2}40			$4x10^{-10}$	
Ra^{-2}26				$5x10^{-6}$
Sm-151	$2x10^{-6}$			
Sr-90		$8x10^{-7}$		
Tc-99			$2x10^{-6}$	$4x10^{-5}$
Th^{-2}29				$2x10^{-8}$
Th^{-2}30				$5x10^{-6}$
Th^{-2}32				$2x10^{-15}$
U^{-2}33				$2x10^{-6}$
U^{-2}34		$1x10^{-6}$		$6x10^{-3}$
U^{-2}35		$5x10^{-7}$		$8x10^{-8}$
U^{-2}36				$2x10^{-6}$
U^{-2}38				$4x10^{-4}$
Total	$3x10^{-6}$	$4x10^{-5}$	$2x10^{-6}$	$1x10^{-2}$

a. With the exception of the WCF, the contamination source for the GWSCREEN runs was assumed to be at what is currently the south fence of the INTEC. The contamination source for the WCF is assumed to be directly below the facility. The residential scenarios were assumed to be at 100 years for each of the facilities except the Tank Farm. It was assumed that the tanks would not breach at the Tank Farm for 500 years, so this risk assessment is based on a 500 year residential scenario.
b. See Rood et al. 1996.
c. See Stepan and McCarthy 1997.

APPENDIX C – CUMULATIVE IMPACT METHODOLOGY

The Council on Environmental Quality's National Environmental Policy Act regulations require agencies to consider (1) actions that when viewed with other proposed actions have cumulatively significant impacts, and (2) impacts that may be cumulative. For the most part, Environmental Assessments (EA) have not covered cumulative impacts very well. The rationale in many cases is that EA and Finding of No Significant Impact mean that there are no significant impacts and thus any cumulative impact is insignificant. This however, may not always be the case. It may be a situation where "2+2=8," that is, a number of small insignificant impact could eventually reach a threshold, resulting in a significant impact.

This EA looks at impacts from this project in the following manner.

1. Define the Region of Influence
2. Define the Affected Environment
3. Define Coincident Actions and Effects
4. Aggregate Effects
5. Assess significance.

For this EA, we need to look at potential cumulative impacts of the following: Health and Safety (risk assessment), Air Resources, Cultural Resources (Historic), Water Resources, Land Use, Aesthetic (Scenic Resources), Waste Management, Ecology, and Geology and Soil. The EA discusses each of these resources based on the following Regions of Influence (ROI): INTEC (within the fenced boundary), INEEL, Snake River Plain Aquifer, South East Idaho, and Nationwide.

Table 34 associates each resource with a its potential ROI. Most impacts from the proposed action are limited to the INTEC and INEEL. Some, however, have the potential to affect larger areas, such as South Eastern Idaho and nation wide. The discussion in Section 4.5, ***Cumulative Impacts*** discusses the spatial aspects of cumulative affects. The "End State" for the INTEC targets a time near 2050. However, this EA assumes that the INTEC would remain in institutional control, even after achieving the "End State" for a very long time. Examples of other activities that add to the cumulative impacts include (1) closing HLW facilities such as the tank farm, (2) constructing new facilities on the INEEL such as the "wind" facility, (3) closing the RWMC.

Table 34. Resources and Regions of Influence.

Resources	Region of Influence	EA Section
Air	INTEC, INEEL, South East Idaho	4.5.1, page 37
Geology and Soil	INTEC	4.5.2, page 38
Water	INTEC, INEEL	4.5.3, page 38
Biological (Ecological)	INTEC, INEEL	0, page 39
Cultural and Historic	INTEC, INEEL	4.5.5, page 40
Land and Visual	INTEC, INEEL, South East Idaho	4.5.6, page 40
Health and Safety (Risk Assessment)	INTEC, INEEL, Snake River Plain, South East Idaho	4.5.7, page 41
Waste Management	INTEC, INEEL, Nation wide	